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ABSTRACT

The purpose of this project was to study the feasibility of coordinating educational information systems and associated data processing efforts. A non-profit organization, representing key educational agencies in the state of Minnesota, was established to advise and guide the project. A statewide conference was held under the auspices of the Governor to mobilize interest, to provide and disseminate information, and to do preliminary planning. A status study was conducted which covered all institutions in the state and included hardware utilized, plans, training of staff and special projects and efforts that might be underway. On the basis of the conference, the status study, and subsequent meetings, a basic overall plan for the coordination and development of information systems in education in the state of Minnesota was completed and disseminated. Appendixes include a report on the conference, the status report, and the resultant state plan. (JY)

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FINAL REPORT
Project No. 8-F-001
Grant No. OEG-6-8-008001-0006

A STUDY FOR THE COORDINATION OF EDUCATION INFORMATION AND DATA PROCESSING FROM KINDERGARTEN THROUGH COLLEGE

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September 1969

U.S. DEPARTMENT OF
HEALTH, EDUCATION, AND WELFARE

Office of Education
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U.S. DEPARTMENT OF
HEALTH, EDUCATION, AND WELFARE

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Educational Research and Development Council of Central Minnesota

Educational Research and Development Council of Northeast Minnesota

Educational Research and Development Council of Northwest Minnesota

Educational Research and Development Council of Southern Minnesota

Educational Research and Development Council of Southwest and West-Central Minnesota

Educational Research and Development Council of the Twin Cities Metropolitan Area, Inc.

Edu-Cultural Services Center

Midwestern States Educational Information Systems

Minnesota Association for Educational Data Systems

Minnesota Association for Supervision and Curriculum Development

Minnesota Association School Business Officials

Minnesota Catholic Education Association

Minnesota Education Association

Minnesota Elementary School Principals Association

Minnesota Federation of Teachers

Minnesota Higher Education Coordinating Commission

Minnesota School Boards Association

Minnesota State College Board

Minnesota State Department of Education

Minnesota State Junior College System

Minnesota State Planning Agency

Minnesota State Teachers Retirement Association

University of Minnesota

Upper Midwest Regional Educational Laboratory

INTRODUCTION

This study was carried out in relation to a number of studies in process or completed in Minnesota which were concerned with information systems and data processing.

The purpose of this project was to study the feasibility of coordinating educational information systems and the associated data processing efforts. The study was aimed at uncovering the existence of common data needs among educational organizations operating at all educational levels and to provide recommendations concerning the procedures for affecting coordination and compatibility among the several systems now being developed. The project sought to facilitate communications between educational organizations and institutions and illuminate the areas where coordination is needed.

CHAPTER I.

Overview and Perspective.

Today more than ever we are faced with the problem of active interested involvement in social problems and policies. During the most recent election held in 1968 for president, more eligible voters failed to vote than at any other time in our history. It is clear that more and more of our citizens are alienated from the society in which they live. This is clearly due not only to increase in size but also to an increase in the impersonalization of human relations.

Occasionally there is a technical development of enormous importance. The development of the computer is such a development. It has developed very rapidly during the past 15 years so that the ability to make and use the actual machines has moved ahead much more rapidly than society's ability to adapt to these machines and get maximum use from their very great potential. The problem is made much more severe by the fact that computers are potentially a very powerful force for increasing impersonalization and because of the rapidity that they will become available and used by large segments of society.

As computers are developed, they will not only become more available but will be far more flexible and adaptable in their applications. In education it is clear that they will be used more and more for computer-assisted instruction rather than for narrow data processing kinds of activity. Therefore, the educational community must adapt not only to changes in numbers of computers but also in their functions. These kinds of developments place an enormous burden on the planning and management functions available in education. It is clear that isolated efforts by various educational agencies would be almost complete chaos. It is clear that joint effort by all of the various educational agencies is vitally necessary.

Despite the fact that joint effort is so crucially necessary, there is relatively little incentive or even motivation for the various educational agencies to work together. On the other hand, there is the probability that the various agencies may feel that it is best to simply look out for themselves and go it alone. It turned out that many agencies did feel that they would have to go it alone simply because there was no means by which they could participate in planning.

In the first phase or pre-project era, much effort was devoted by the Minnesota National Laboratory staff to locating and identifying interest in planning to use computers in education. Meetings were held and a group was organized representing all educational groups in Minnesota that were concerned with computers in education. This group was very valuable in elucidating the attitudes and interests of the educational community.

After several meetings which were held in 1967, it became clear that three areas emerged of major significance and may be listed as follows:

1. The need for a major involvement of educators, computer specialists, community leaders under the leadership of the Governor.

2. The need to determine and disseminate information about the status of computers in education in the state.

3. The need for a model or plan that could be used to guide planning and development of computers in education.

The major effort of the project was directed in these three areas and resulted in the following products:

1. For area of major involvement, the product was a Governor's Conference and the report which is part of this report and is entitled, "Report of Governor's Conference on Computers in Education."

2. A status study of the use of computers in the state and a report entitled, "A Status Report of Electronic Data Processing in Education in Minnesota."

3. An overall statewide plan entitled, "Characteristics of a Network Model for Regional Information Systems for Minnesota Elementary and Secondary School Districts."

All of these reports are included in this report and are the major products of the project that can be readily communicated. Considerable effort has been made to report these efforts fully as they may be helpful to others. It may be noted that the group formed as an interest group became the Minnesota Council on Educational Information Systems and was of great importance to the project and to keeping the results of the project alive and working.

The Minnesota Council on Information Systems (MCEIS) proved to be a very interesting development in itself. It was formed by 26 key educational agencies in Minnesota and formed itself into a non-profit association. The Lab provided assistance with staff work including clerical services. In return, the agencies in MCEIS provided the Lab with very valuable services of consultation and guidance. While there was little to motivate the agencies other than internal motivation, there was, nevertheless, social reciprocity which still functions in our society much as it did when one farmer aided another in turn for being aided. Some may regard the social reciprocity model as rather shallow; however, it formed a stable and workable means for achieving cooperation and active participation.

The activity of planning the Governor's Conference proved to be extremely useful. Soliciting the cooperation of the Governor and explaining the program to him and his staff aided greatly in bringing the needs of this area directly to the Governor's attention. There are doubtless many ways that this could have been achieved; however, this proved to be especially effective. The Governor's participation on the program also was very helpful.

The Governor's Conference proved to be an exceptionally good means for motivating participants. The top leadership of the state brought response from those both from within Minnesota and outside of the state. This means for mobilizing interest and participation is strongly urged. It is not costly. Virtually all participants and speakers paid their own expenses or they were paid by their organizations. All of the other expenses of the Conference were also sustained by a small extra charge for luncheon tickets.

More than 400 persons attended this conference and a report was generated on the basis of this conference. Additional description of this conference is presented under Chapter 2 and a report of the actual conference materials presented is shown under Appendix A. This report has been widely disseminated and was very useful as an aid to planning. The status study was planned and conducted parallel to the Governor's Conference. The information gathered in this way becomes out-of-date quite rapidly but once the base is established, it is easier to maintain the information. This information was utilized by the Governor's Conference as basic information and was also used in subsequent planning sessions. Additional comments are made about this survey in Chapter 3 and the results including the forms utilized are shown in Appendix B. Much of the information in this part is out-of-date, but there is considerable information which illustrates the structure of information systems in the state including aspects of hardware, training, organization and plans. The basic forms and approach proved to be very satisfactory. It would be very desirable to conduct such a study not less often than once yearly. The information collected is valuable but of even more value is the sensitizing of various groups and individuals to the need for specific information in order to do effective planning. Without specific information available, it is very difficult for groups to be effectively involved in the planning process. Planning then becomes the exclusive domain of a very few specialists who happen to have acquired quite a bit of information in varying states of relevance, validity and accuracy. Frequently, the specialist does "carry around in his head" quite a store of useful information; however, this information is of limited use to the broad spectrum of persons in education who should be actively involved in planning to use computers in education. Therefore, a status study and report are essential to planning even though the specialist may find fault with some of the details. The report is not done for specialists as much as it is done for professional and related educators who are not computer specialists. It was felt by the planning groups who met that planning for the use of computers in education must not be left in the hands of computer specialists. They should be involved but as equal partners and not as a party in position to make unilateral decisions.

Finally the report which was developed to provide a plan for the development of information systems in education was the result of many meetings in which both information experts and educational experts discussed and analyzed both information and opinions. The final plan was the result of many persons working closely together. This plan is being broadly disseminated to those agencies and individuals concerned with educational information systems.

Summary:

The project,"A Study for the Coordination of Educational Information Systems and Data Processing From Kindergarten Through College," was devoted to applying the techniques of group decision and social influence to enhancing coordination, organization and cooperative development of educational information systems throughout the State of Minnesota. A non-profit organization was established representing 26 key educational agencies in the State to guide and advise the activities of the project. These were agencies such as the Minnesota Educational Association and the Minnesota School Boards Association with very broad influence in forming educational policy. A statewide Conference was held under the auspices of the Governor of Minnesota to mobilize interest, to provide and disseminate information and to do preliminary planning. Concurrently with planning for the Governor's Conference, a Status Study was conducted which covered all institutions in the state and included hardware utilized, plans, training of staff and special projects and efforts that might be underway. In addition more than 20 meetings were held for discussion and planning. On the basis of the Governor's Conference, the Status Study and subsequent meetings, a basic overall plan for the coordination and development of information systems in education was completed and disseminated.

CHAPTER II.

The Governor's Conference on Computers in Education.

The Governor's Conference on Computers in Education provided an excellent opportunity for dialogue among Information Systems staff. This communication was very much needed and many new channels of communication were established. The prestige and interest of the Governor were of great value. In Minnesota, the Governor is Executive Officer of the State Planning Agency. The State Planning Agency has direct authority for overall planning for education in the State. The Governor and his staff were most cooperative during all phases of this conference.

The staffs of both public and private educational agencies participated actively and cooperatively in planning this conference. An Association of agencies was formed under the title, "Minnesota Council on Educational Information Systems." The twenty-six agencies were as follows:

Educational Research and Development Council of Central Minnesota
Educational Research and Development Council of Northeast Minnesota
Educational Research and Development Council of Northwest Minnesota
Educational Research and Development Council of Southern Minnesota
Educational Research and Development Council of Southwest and West-Central Minnesota
Educational Research and Development Council of the Twin Cities Metropolitan Area, Inc.
Edu-Cultural Services Center
Midwestern States Educational Information Systems
Minnesota Association for Educational Data Systems
Minnesota Association for Supervision and Curriculum Development
Minnesota Association School Business Officials
Minnesota Catholic Education Association
Minnesota Education Association
Minnesota Elementary School Principals Association
Minnesota Federation of Teachers
Minnesota Higher Education Coordinating Commission
Minnesota School Boards Association
Minnesota School Districts Data Processing Joint Board

Minnesota South District of the Lutheran Church Missouri Synod
Minnesota State College Board
Minnesota State Department of Education
Minnesota State Junior College System
Minnesota State Planning Agency
Minnesota State Teachers Retirement Association
University of Minnesota
Upper Midwest Regional Educational Laboratory

In addition to their time and effort, these agencies contributed $25.00 each. In efforts such as this effort at voluntary communication and organization, it is essential to gain commitment from the agencies that have power and are actually responsible for programs.

One of the first problems following commitment to the Conference is to devise or derive an invitation list. Of first importance are those individuals that are suggested by the Governor and his staff. Next, the twenty-six agencies making up MCEIS were asked to submit fifty names each for the list. MCEIS members were asked to select individuals from the educational community with positions of responsibility. All State legislators, School Board Chairmen and Superintendents were invited.

It is clear that those in attendance are a remarkable cross section of the power structure and the expertise related to information systems. Private business, teachers, programmers, administrators, school board members, professors, and many other areas of interest were represented and were well-balanced with other interests.

The techniques utilized in building the invitation list proved to be highly useful. They provided a means for the actual participation by many interested persons.

The next step is the substantive design of the program. This includes topics to be included and the basic structure that will be employed. The members of MCEIS participated very actively in drafting and revising the program. After several revisions, a program was agreed upon and approved by the Governor.

Finally, the staff for presentations must be selected. These staff members were selected in terms of their knowledge of the field and of their ability to communicate effectively.

Planning, preparing and mobilizing interest for this Conference brought staff from Information Systems together and established the pattern of working together to achieve a common goal. The climate of cooperation and the free exchange of ideas was very evident. Much was accomplished in the Information Systems community to clarify issues and cooperatively plan to meet these issues.

The meeting itself was attended by more than 400 persons. As can be noted from the roster of attendance, there were many outstanding persons in attendance. The spirit of the Conference was lively and the presentations were excellent. Very few persons had left the Conference when it ended officially at 4:30 p.m.

Those in attendance expressed the feeling that it was a most unusual and interesting meeting and accomplished the following:

1. Brought many key persons into contact with one another for the first time.

2. Established many new channels of communication.

3. Provided much basic information for planning.

4. Induced a favorable climate of cooperation and communication among staffs of agencies.

5. Provided stimulating ideas and basic information and education.

Following the Conference, a report or summary of the Conference has been prepared. This report includes presentations and the material presented in panels. This report is shown under Appendix A. The members of MCEIS have indicated a desire for several thousand of these reports for distribution.

It is planned that 4,000 copies of this report will be printed at State expense. Subsequent to the Conference, MCEIS was placed on a permanent basis independent of the Minnesota National Laboratory. MCEIS will continue to work actively in carrying out the goals of the Conference.

MCEIS represents an outstanding example of voluntary efforts to cope with the problem of the coordination of the development of the use of computers in education. It enables citizens to have a method of solving their own problems.

Perhaps MCEIS is not enough but it has made a significant contribution and will continue to be a very effective instrument in the area of information systems.

<u>SUMMARY</u>: The Minnesota Governor's Conference on Computers in Education consisted of the following:

1. Planning the Conference

    A. Invitation List
    B. Substance
    C. Staff

2. Formation of MCEIS

    A. Role of MCEIS
    B. Future of MCEIS

3. Conducting the Conference

4. Report of the Conference

5. The role of MCEIS and the report for long-range planning

CHAPTER III.

A Status Report on Electronic Data Processing in Education in Minnesota.

The planning group which met under the auspices of the Midwestern Information and Education Project (the 13 States Project) early recognized the need for a study of Educational Information Systems as they exist. Later the Upper Midwest Regional Educational Laboratory contributed its efforts to planning and it was again emphasized that lack of knowledge of existing programs was a great impediment to planning or even to meaningful discussion. It should be noted that this planning group gradually expanded and evolved into the group known as MCEIS as listed in Chapter II.

The group met to discuss the kinds of institutions that should be included and the kinds of information that should be included in the study. The group made many valuable suggestions and the success of the survey may be attributed to the guidance and participation of this voluntary group. It is possible to observe the great importance of having local groups participate in planning at a very early stage.

The basic forms were developed, tested, revised, tested and finally completed in their present form as shown in Appendix B. These forms were found to be quite effective and efficient in eliciting (by mail) the information needed.

It would be very desirable to have this data constantly updated. The field is very rapidly changing and it is clear that the information becomes obsolete quite quickly. The approach and basic information have been established, however, and the first step in establishing statewide information has been established.

The Minnesota Council on Educational Information Systems intends to make continuing efforts on its own to maintain up-to-date information on the status of Information Systems in Education. This voluntary effort is certain to be of benefit in maintaining interest in maintaining information on the status of educational information systems.

CHAPTER IV.

The Statewide Plan

This area of the project proved to be more time consuming than anticipated in our original proposal. The approach to both planning and legislative models involved three basic aspects: the participation of informed community leaders; technical computers staff; and educational information systems staff. Also both the private and public interests were represented.

The Statewide Plan as shown in Appendix C is primarily oriented to Minnesota. The work of the Governor's Conference was of great importance to creation of the climate and channels of communication essential both for planning and for the development of legislative models. Prior to this work very little statewide planning had been achieved. On the other hand, prior to this project the development of educational information seemed to be characterized by competition and divergence.

The greatest contribution of this project has been to bring together the various diverging developments and lay the ground work for coordinated planning and compatible systems. Much work remains to be done. However, the basic patterns have been established.

The techniques of planning which were employed were those of successive approximation, review by a panel of experts and continue to rebuild the model. Following the status survey and Governor's Conference, a considerable amount of information had been gathered.

Planning, however, was still extremely nebulous. It was found that additional staff was necessary for leading the planning effort. Dr. Van D. Mueller of the University of Minnesota and consultants from hardware and systems analysis were hired to lead and structure planning. Hiring of these specialists proved to be critically important.

It had been important to bring many persons together for discussion. Despite these discussions, however, there was the following:

1. Relatively poor efficiency in communication among information systems staff.

2. A climate of defensiveness still tended to characterize the attitudes of informations systems staff and the role their agencies might play.

The plan which finally was developed recognizes that educational development in a state is pluralistic. This means that there are many interests, abilities and stages of development that go into educational policy and practices. Local boards, State Department staff, school district staff, professors, colleges, universities, legislatures, and many many things go into the final makeup of education.

The plan which we have devised fully recognizes this basic fact of educational life. The chief problem with information systems planners is that they may take a monistic view. For example, Department of Education staff might tend to see educational information systems as an instrument developed by and for the Department. The pluralistic view acknowledges the importance of the Department but only in relation to all of the other components of the educational system.

It is extremely important for the leaders in information systems planning to have a balanced view of the many facets and aspects of education. The plan must be uniform in many respects but retain flexibility and adaptability. It must be sensitive to reality and yet sufficiently robust to provide a permanent conceptual structure within which educational information systems can develop with maximum effectiveness.

The plan and model which has been developed is the result of many persons, agencies and disciplines working together. It would be a shame to suggest that they were so many willing working or busy bees. There was a very serious problem of keeping the group involved actively and within the psychological field of problem solving.

It is of great interest to note that there is very little intrinsic motivation available in our society to accomplish many very important goals. Planning of educational information systems is a good example. Despite the many agencies and professions in educational information systems there is virtually no one who has a stake in overall planning and coordination. Therefore we must use the various forms of intrinsic motivation to achieve our objectives.

Plainly stated this means that in terms of short-term selfish goals there "is nothing in" coordination. It is necessary to identify with long-term broadly defined social and educational objectives in order to engage the intrinsic motivation which is of critical importance to this planning effort.

The plan which evolved was developed along the lines described and proved to be both technically, educationally and socially sound.

APPENDIX A

Report of Governor's Conference on

Computers in Education

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I. Introduction

During the past ten years the use of computers has expanded rapidly in education. At the federal, state, and local level there is increased use of computers in many different phases of education.

Computers are now used in the classroom, in administrative decisions and in the routine bookkeeping operations of schools. There are now many Minnesota educational organizations that are working in and close to information systems and data processing. There organizations have formed an organization called the Minnesota Council on Educational Information Systems (MCEIS) and this organization was headquartered in the Minnesota National Laboratory Offices.

The Minnesota Council on Educational Information Systems in cooperation with the Minnesota National Laboratory (a research agency of the Minnesota State Department of Education) sponsored a Governor's Conference on Computers in Education under the auspices of Governor Harold LeVander. The conference brought together outstanding persons to discuss and plan for the more effective use of computers in education. Panels were organized around the use of computers to aid decision systems in education, in the classroom, and in the organizing and financing of computers in education.

The main goal of the conference was to improve coordination and communication by bringing a broad segment of the educational community together to exchange information and views on what is available and how it can be used more effectively and how agencies can work together to plan to use computers as effectively and efficiently as possible in meeting the educational needs of our children. There were 365 participants at the September 26, 1968 Conference. A listing of those in attendance is shown in Appendix B.

March 19, 1968

Mr. Duane J. Mattheis
Commissioner of Education
Minnesota Department of Education
Centennial Building
St. Paul, Minnesota 55101

Dear Commissioner Mattheis:

I am pleased to approve your current request for conduct by the Minnesota Department of Education of a state-wide conference on the role of computers in the evaluation, planning and development of an effectively coordinated and strengthened educational program.

Because of my strong personal interest in both education and the value of applying modern data processing to government, I intend to participate in this conference to the extent my schedule will permit.

I will appreciate advisory reports on the development of the program for this conference by your Department in cooperation with the Minnesota National Laboratory and U.S. Office of Education.

Sincerely,

Harold LeVander
G O V E R N O R

HL:rs

cc: Mr. W. W. Keenan, Administrator
Minnesota National Laboratory
295 North Griggs-Midway Bldg.
St. Paul, Minnesota 55104

III. Presentations

A. Greetings from Jean LeVander King, daughter of the Governor.

Governor LeVander relays his welcome and best wishes to you on this first Conference on Computers in Education. Unfortunately he cannot be with you to greet you personally because he is on his way to Washington for a meeting of the Education Commission of the States. However, I am sure he would be most impressed with the great interest evidenced in this seminar by the tremendous attendance.

The importance of the role of computers in education has not received adequate attention. The modern computer became available commercially some 20 years ago. In fact, Minnesota is the home base for three of the country's five leading computer companies.

However, our leadership in the design and manufacture of computers has not been reflected in our use of computers in government and education. The computer can play three prominent roles in education.

First, it can serve as an auxiliary teaching device. Secondly, computers can serve as an information system. With 25,000 technical reports, 400 books, and 3,500 articles being produced weekly in the United States, the sheer volume of new knowledge requires an information processing system.

Thirdly, computers themselves are a necessary concern for the student. Every student at both the high school and college levels should be exposed to a basic understanding of computers and computer systems and the impact they have on society.

The Governor certainly appreciates your interest in the subject of computers in education and eagerly anticipates your recommendations.

Very best wishes for a successful conference.

B. "Computers in Education"

Dr. R. Louis Bright, Associate Commissioner for Research, United States Office of Education

We are rapidly becoming a computer-assisted society. Few areas of our lives are not affected by these amazing machines which appeared less than 20 years ago. Already they schedule vast steel mills, train leaders of business, check income tax returns, and guide rockets to Venus. College students are even using them for the most personal of matters - to find dates for themselves.

What does this mean for educators? It means that unless high schools and colleges start telling their students how their lives and work will be changed by computers they are selling them short. A report from the President's Office of Science and Technology on use of computers in higher education asserts that any four-year liberal arts college that does not give students experience in data processing techniques has severely cheated its graduates educationally. I would carry this one step further. The high school which ignores the impact of computers is just as obsolete.

Some computerized techniques are within reach of the average high school and college right now. A study supported by the Office of Education's Bureau of Research shows that if several schools use the same computer facility, it would cost an average school district no more than one percent of its total budget to take advantage of several important computer applications. For example, figures indicate that to serve 120,000 elementary pupils, 40,000 secondary schoolers, and 2,000 college students, the cost of equipment, with 486,000 students, would be about 1.7 million dollars annually. These amazingly low figures were drawn from a study of the cost of servicing 50 high schools and junior colleges with a central computer facility.

This is no vague, futuristic supposition; it is a very practical system that conceivably could be operating within two years. The secret of its success is the regional approach. One computer would serve school districts for one hundred miles around. The computer would give these schools three things for their money; it would provide routine administrative services, offer instructional support for computer job training, and give every student in those schools the opportunity to learn how to use modern data processing techniques.

This computer would help both the elementary and high schools with administrative tasks -- recordkeeping, testing, and even scheduling. Certainly this would save time and money for the school system but the greatest benefits would fall to the students, largely to those in the secondary grades. Through remote terminals, either teletype machines or fast card readers, students could be taught data processing skills. They could learn the symbolic languages that must be fed into the machines and experiment with high-level programming.

Vocational students could learn these skills in greater depth along with the related skills of business systems analysis, file manipulations, etc. Public education can perform one of its greatest services for the disadvantaged by training them in computer jobs. Few of these jobs require more than a high school education. Industry hires college graduates for its computer training programs not because the positions demand this higher education but because college graduates are usually easier to train.

Regardless of their career plans, all the students would have some contact with the computer system. For instance, they could feed math, physics, and statistical problems into the machine and get rapid-fire solutions. With this kind of a start, students will think of using the computer to solve realistic problems all their lives.

This is extremely important for future professionals who may find their jobs in the process of transformation as soon as they graduate from college. Computers have already made drastic changes in management and engineering, and soon they will be affecting law, medicine, science, architecture, and education. It's hard to imagine a field which won't be nudged by the computer. Students have to be prepared to face this challenge. It is an enormous task; no university is even close to meeting it.

But computers will touch far more of the average citizen's life than his job. It is up to the schools to make him feel comfortable with these ubiquitous machines. There is a psychological barrier here. At an eastern junior college last year, the computer's advent led to angry strikes by students who objected to the impersonalization of just becoming numbers in a strange machine somewhere in the basement of the administration building. They were probably mistaken; computer scheduling systems can actually counter impersonalization in today's large institutions. A computerized scheduling system at Purdue University, for instance, gives each student a chance to pick the professor he wants for every course. Consequently, students get their first choice of professors about 78% of the time, against about 22% under the old manual system.

Students should be given enough realistic information about computers to separate fact from fantasy. They should be able to overcome fear of the unknown — the fear that makes people resist some of the most valuable computer applications. On the other hand, they should know enough to spot the danger in case technology is misapplied. Students who have daily contact with computer techniques in their high schools and colleges will probably learn most of this by osmosis.

Until now we have just been experimenting with computers in education. With the regional approach described in the feasibility study, however, it should be possible to provide high powered computer services to the schools in the very near future. Judging from the number of schools experimenting with such methods even before they were economical, I'd predict this system will be in a large number of schools in the early 1970's.

This feasibility study indicates one of the greatest contributions research can make to education today. It will help schoolmen determine from the vast amount of educational technology available what is economically sensible and what is just educationally nice to have, at least at this point. Now we know that some computer services can be made available to schools at a price they can afford: still in the offing are computer-assisted instruction and numerous other applications of technology that will eventually be within the reach of the school system.

Nevertheless, educators should keep an eye on some of the more exotic computer applications because these, too, may be economically feasible in the next decade. On the administrative scene, computers may alter our entire concept of the classroom with their fantastic ability to reschedule classes. New flexible scheduling systems make it possible to reschedule an entire high school every two weeks, so that every student is almost always in a "class" that suits his individual needs.

Purdue University uses the computer to plan new buildings. It takes various proposed building layout options on the basis of projected number of teachers and students for each course and juggles them to design the most effective facilities. Purdue claims the system has saved about $30 million over the past five years. The same principle should work just as well for high schools.

Computers will be shaping what goes on in the classroom as well as the building where learning takes place. They will be grading papers, giving tests, and in many cases, actually teaching the students. One of the most time-consuming tasks in professional education, the grading of English papers, may be taken over by these instruments. Imaginative researchers at the University of Connecticut have come up with the surprising but well-confirmed result that a computer-s grading and comments on essays are indistinguishable statistically from those of the English professors. (I have not fully resolved in my own mind whether this is a comment on the computer or the professors.)

In the realm of testing, the computer has two great advantages: it can make standarized tests truly standardized - each child receives test instructions in the same tone of voice - and it can skip large blocks of questions that are clearly too easy or too difficult for the student. The machine automatically selects question areas which point up the student's weak points and prescribes study materials he needs. This has special value in testing students with diverse backgrounds -- first-graders, high school remedial groups, and adults.

The New York Institute of Technology has been using a system that points up the computer's possibilities in instruction management. Each student pursues self-study in a standardized college text and takes a multiple-choice quiz over each unit. He feeds his answer sheet into a computer which does three things: It keeps his record current, indicating missed questions and correlating them with past errors to detect a pattern that may guide his adviser. It provides data for updating the curriculum by analyzing the responses to the questions to determine whether some are giving unexpected difficulty to certain types of students. And last, it hands the student a list of questions he missed, naming three extra tests and the page numbers where the same material is presented by a different author. If he scored 85 or better, he gets a new assignment; otherwise, he must look up the references and retake the test.

Such computer uses will give teachers more time to help each student individually in ways that are inconceivable in traditional classrooms. Freed from routine chores like recordkeeping, grading, and drill and practice exercises, the teachers will have more time to teach. They'll do things the machine can't do: teach students to speak effectively, to express their ideas, to communicate with others.

Perhaps the computer's "human" qualities stand out best in computer assisted instruction, where the machine can tailor instruction to the needs of each individual. In teaching reading, for instance, the machine can help each student form sounds or recognize letters. Through audio and pictorial messages, it can reach children who have never seen the alphabet or the number system. And the computer never loses its temper -- a characteristic that is extremely valuable for teaching young children.

Computers are also effective teachers for illiterate adults who may feel too humiliated to take advantage of what educational opportunities they have. The computer can't embarrass them; it deals with them individually with no critical human eye to watch their performance. The machine also acts as a "contingency reinforcer"; it can reward a student immediately for work well done. If the lesson is too tough for him, it prescribes material where he can be successful. This instantaneous reward technique shows striking results in motivating both adults and school-age students from disadvantaged families. It can boost confidence and utterly change personality in children who have rarely experienced even the smallest success or received a reward for academic work.

School libraries will be feeling the effects of computers soon. Eventually students may not even have to leaf through books to get information. A West Coast organization has already placed an entire child's encyclopedia in a computer so that the youngster can ply the computer with questions like "What do birds eat?" and get a patient answer. A little further in the future, local libraries may be completely transformed. There will probably be a few centralized information centers with vast collections of information on specific subjects. These would be hooked up to the "local libraries" - computerized facilities throughout the country where the borrower would simply request any material he wanted. No matter how obscure, the material would be located, and would travel electronically from the central facility to the local one. Information retrieval would be instantaneous and completely automatic.

In research, the sheer computing capacity of these machines enables investigators to follow many avenues that were blocked when they were restricted to the old desk calculator techniques. The impact is felt in every quarter of social and education research through new possibilities for vast statistical correlations. But computers can do far more for researchers than handle data. They are sharp detectives of the many obscure, elusive processes that are a part of learning.

Thanks to the computer, physiological research is beginning to unfold much hidden information about the learning process. Continuous monitoring of eye movements may re eal unsuspected reading difficulties. Eye dilation seems to be a measur of comprehension and blood pressure may indicate how much effort a student has to put into learning. All these movements can best be traced by computer.

I believe the computer has real potential for teaching art and music. In addition to teaching the rules and structure of harmony, it could teach the discriminations basic to the recognition of pictorial composition and musical themes. And who knows, it might even teach perfect pitch!

The machine can simulate many situations, either by imitating real life or by games. They can mimic the inside of an aircraft, a complex laboratory, or the 16th century mercantile system. Students get a realistic feel for the subject by being involved in it.

In educating the handicapped, the machine can make its communication with the blind entirely verbal; with the deaf; entirely visual. There are psychological advantages: experiments dramatically show that some emotionally disturbed students who reject humans will relate to hardware.

The computer is already an extremely effective teacher of mechanical skills, and experiments indicate that it may soon be a right-hand man to the vocational counselor as well.

I have sketched an exhilarating future for education, where the computer is a mainstay in the classroom, the business office, the library, and the laboratory. While the computer is ready to go to work in many areas, there are still questions that research must answer. What characteristics of the machines are most valuable in the classroom? What special language will enable curriculum people to insert course material into the machines with ease and retrieve data on student performance? What will the teacher's role be like in the computerized classroom? What problems would arise from bast information retrieval networks concerning copyrights, privacy, and regulatory necessities? Such questions will undoubtedly be the subject of careful study.

In the meantime, however, there is no point in concentrating on the problems while opportunities for using computers slip by. Universities with computerized research facilities tend to do just that; they press for glamorous new developments and ignore the practical services-accounting, data processing, vocational training, and even computer-assisted instruction -- that could be offered right now. When they try to do both functions, one or the other usually suffers. Such institutions may have to utilize two types of facilities, one to supply the institutions' operating needs and the other to pursue research.

The Bureau of Research is currently supporting studies in nearly every area where computers touch education. In California and Iowa, the Bureau has supported State efforts to standardize information retrieval systems. There are more than 30 library studies under way under the Bureau's new Library Science and Information Program. With Federal support, computers are being developed for almost every phase of administrative management and they're already teaching children in a number of classrooms throughout the Nation.

Thus, on all education fronts computers are beginning to have powerful impact. I am firmly convinced that within the next decade we will see these remarkable instruments bring about revolution in the classroom and the entire educational process equivalent to the one already wrought by computers in industry.

C. "Instructional Uses of Computers"

Dr. Russell Burris
Center for Research in Human Learning
University of Minnesota

The facts that a conference entitled "Computers in Education" has been called by the Governor of Minnesota and that so many people are in attendance indicate the anticipated significance of the machine's impact on procedures and practices in education. The impact already has been tremendous in science, technology, the military, and business. Many people feel the scene will be true in the field of education. I am certain that no one in this room doubts the importance of the machine for society in the decades ahead. In other words, in the next few decades the students in our schools will be making use of the machine in ways we cannot now imagine, yet we do not doubt its importance. My statements are to put into perspective the implications of the machine for instructional practice in our schools. This paper hopefully will indicate my excitement as well as my concern as we progress toward instructional applications of the machine. As one examines current uses of the computer today there is good evidence for the importance of the computer in instruction . I am not sure, however, that I share Pat Suppes' prediction that "in a few more years, millions of school children will have access to what Philip of Macedon's son Alexander enjoyed as a royal prerogative, namely the personel services of a tutor as well informed and responsible as Aristotle." My major concern at this time is that we educators will know how to use the machine and use it well. Current efforts at application have been neglected or ignored by many educators; at the other end of the spectrum, some have shown a naive willingness to jump into the applications.

My objective today is to provide information and to point out many problems which remain which will aid you in the difficult if not painful decisions you face in the months and few years ahead.

In order to accomplish this objective I will present examples of current applications as well as experimental and developmental efforts going on in the field. I will also speculate on a few future possibilities and probabilities in instructional uses of computers and finally I will give you my assessment and evaluation of the current state of the art.

Let me give some of my credentials to indicate the position from which I view this area. From my days as a high school teacher of mathematics and psychology I have been concerned with a more systematic application of our knowledge about the learning processes to the instructional responsibilities in education. Through graduate school and my more recent experience, that has remained as my major professional interest. For more than a decade I have been involved in and excited about the programmed instruction area. This excitement has remained although most of what I saw as applications of programmed instruction in education and training I considered fiascos. The excitement remained because I feel we are making progress toward improving instructional environments although not so rapid progress as most of us would like. More than two years ago, I made my first attempt in using the computer as a powerful control device in a teaching-learning situation involving engineering graphics. That experience was at the same time humbling and exciting. Since last spring, I have been principal investigator of a grant within the Human Learning Center at the University having to do with computer-based research in optimizing and evaluating instruciton. This involves research faculty across the basic to applied spectrum with support from graduate students and highly competent computer scientists. I will give some illustrations and comments about this project later.

Before giving illustrations of current applications, let me say something about the hardware and software available today. Several machines of various sizes and from different manufacturers are being used. In addition to the more familiar general-purpose systems, special-purpose, computer-aided instructional systems have been announced officially by IBM, RCA, Philco-Ford and Techomics. Activity is apparent within CDC, Honeywell, Univac, GE, Westinghouse and Burroughs. Software packages exist for many of the general-purpose as well as, of course, the special-purpose systems for conversational interaction and time-sharing, the two major requirements for instructional uses. Further, programming languages and systems are currently available which allow execution of computational programs line by line, linguistic processing in a similarly interactive mode, operating on a simulation model in a relatively uncontrolled way, etc. All of this is to say that the available hardware and software have more capability than we are able to use effectively.

The first example of current application is one which is familiar to most of you. This is the area of teaching the student to use the computer in the computational mode through various systems. Notable efforts are being conducted in secondary schools, colleges and universities throughout Minnesota. In these applications, the student is given access to the computer through teletype terminals from a central computer utility or directly to an on-site computer through teletype or cards directly to an on-site card reader or even through cards mailed to a distant computer. The instructional objectives of such uses can include teaching computer programming languages and developing problem solving skills in areas which would be impossible without access to the power of a computer. With special programs it is possible to give students access to the power of the computer to solve difficult and complex problems in mechanical and civil engineering, phsyics, chemistry, statistics, business and economics. There is almost no doubt that this kind of use is technically feasible and far from trivial in accomplishing educational goals. There are economic and some educational problems having to do with this kind of instructional use which must be faced, namely, what are the costs among the choice of systems and are the materials and teachers available to use the system effectively. These problems are minor compared to the problems associated with other kinds of instructional uses, however.

Most of us share expectancies in the use of computers to improve teaching and learning. It is equally clear that we do not know yet what the optimal use of the computer should be. There are no well-formulated objectives on which the designers of new instructional systems and products can base their designs. We must admit that current knowledge about the learning process is not sufficient either to give structure and guidance to new instructional systems or to evaluate them comprehensively.

The availability of such powerful computers for instructional purposes is in its way creating an educational crisis. The machines and technology that have been illustrated indicate that we can do anything with or for the students that we want to. Further, it is possible to keep a complete record of nearly every move the instructor and student make through the course. But such power suddenly exposes our inadequacies. All along we, as educators, have stated that a course should have objectives and the content and structure of the course should be determined with reference to these objectives. We have also stated that the course is supposed to be evaluated in light of achievement of the objectives but most of these statements have been hypocritical. There has been little clear meaning to the "structure of a course" and the actual evaluation of objectives has only been weakly appropriate. The relation of objectives to particular steps taken in the pursuit of a course have always been problematical. Many of the cherished beliefs of instructors have never been challenged. Some things an instructor "knew" would be good for his students were never tried because the instructor did not have time, the students did not have the equipment, etc. Feasibility arguments and real limitations protected us from a confrontation with the poverty of our notions about the structure of knowledge and how changes in that structure were to be affected.

In other words, the enormous economy and improved instruction that computers may be able to provide await the development of more powerful techniques operating on and relevant to abstract characteristics of the subject matters involved. Research efforts must be directed toward establishing a firm theoretical basis for computer use in instruction rather than attempting merely to put courses together with old technology. An adequate evaluation of the effectiveness of any newly designed instructional system is not possible without clear appreciation of the deepest objectives of instruction. We must in other words become clearer in our minds of what it is the student is to learn and what it means to know it.

One can teach the isolated facts of any discipline in any order he chooses, but all of us know that some orders would be chaotic and nearly impossible while others would facilitate the development of knowledge by the student in such a way as to maximize his retention of the whole and minimize his difficulty in any particular segment of the series. In parallel fashion one can evaluate knowledge of a subject matter on a gross basis by simply randomly picking items out of a textbook or syllabus. In fact this is probably equivalent to what is usually done. Such an evaluation, however, does not tell us in a systematic fashion what the learner does or does not know or in what way his knowledge differs from the desired state that we hope to obtain. Such tests yeild crude information of very limited usefulness. Before we can anser the more serious problems of the uses of computers for instruction, we must get at the deeper problems of describing the learner's state of knowledge and his advancement in such detail that it can be used to evaluate the success of procedures, programs, experiences and the like which we have manipulated to achieve changes in his state.

D. "The Use of Computers to Aid in the Decision System"

Joseph A. Perkins, Jr.
Peat, Marwick, Mitchell & Co.

One definition of decision is given as settling a problem by giving judgment on the matter. One of many similar definitions of a system is that it is a coordinated body of methods or a complex plan of procedures. The purpose of this paper is to examine ways in which computers can assist school administrators in making judgments about the many complex plans and procedure alternatives.

With the constant increase in the body of knowledge, the expansion of our technology, the need for new skills to solve old and new problems alike it is obvious we are dealing with one constant variable - change. All progress involves change, but not all change provides progress! Since there will always be change, don't let it lead you - be the agents of change for progress by being prepared to make the decisions. Marshall McLuhan has said many things, but one of particular significance is: "The old fashioned institutions will not be reformed, they will be by-passed." So let's examine this problem of controlling change through decision systems aided by computers.

Tasks of School Management

The major tasks of school management have been described in many ways but five seem most meaningful:

1. Planning - The identification of objectives
2. Programming - The designing of programs to reach these objectives
3. Budgeting - The allocating of resources for the programs
4. Operating - The implementation of the programs
5. Evaluation - The analysis of the programmed results for planning.

Decisions are involved in all of these management tasks whether they be in predicting the needs for resources, the providing of resources at the time and in the quantity that they are needed, or in allocating the resources to the parts of the school system in order to best achieve the objectives planned for the system.

It should be obvious to all that none of these tasks are peculiar to school system management. Rather, they characterize top-level management of almost all enterprises.

How are Decisions Made

As stated earlier, decisions are made by giving judgment on a matter. However, the decision-making process has a number of parts:

1. Objective identification
2. Data gathering
3. Data analysis
4. Development of various possible plans
5. Evaluation of these alternatives
6. Selection of the best plan

How can the computer, therefore, aid in this process? In the first case, the identification of objectives, the computer will be of little assistance. More will be said about this later. Data gathering based on a coordinated method is essentially the process of system design, both macro and micro, in order that the data put into a computer can be massaged in a useful manner. Data analysis can be done quite regularly by the computer, obviously much more rapidly than by manual methods. Once the analysis has been completed and the facts arrayed, then a number of conclusions can be developed, evaluated, and finally the best decision selected based on the information at hand.

Decision Information Systems

Today the school administrator is faced with a plethora of historical data. However, historical data alone, though interesting, is no longer a reliable guide to future action. It has become clear that a new approach to the collection and use of information is necessary. Certainly, through the techniques of operations research, meaningful relationships among historical data can be developed but these must be tempered by our rapidly changing body of knowledge, our accelerated time frames, and above all the recognition that change is being demanded. Rethinking of the conventional methods and effectiveness of school programs has to be introduced into the historical pattern. What has been good enough for our fathers and us is not good enough to solve the problems of today and tomorrow.

Because of these reasons the educational management information system (EMIS) has been developed. Starting with the accepted accounting systems based on the various handbook subsystems developed by the U.S. Office of Education, and starting with what was the basic educational data system (BEDS) there are now systems which involve six subsystems, manageable in computers, which may interfere with each other. These six subsystems are:

1. Pupil
2. Staff
3. Facilities

4. Curriculum
5. Finance
6. Community profile

With the educational management information system, you are now provided with a base of information for the decision-making process.

Some Examples

Available to the school administrator today are a number of new computer-based tools. This list below is not meant to be all inclusive, but rather to show the variety currently available to administrators for use in the decision-making process:

1. Flexible scheduling models - Much has been written about these models and their potential in aiding students. They basically assist management in the decision process by forecasting the needs for personnel and facilities.

2. Demand or predictive models - These models take into consideration a large number of environmental variables in the forecasting of student loads. Simulation over extended time frames using many variables cover theoretical conditions in many areas such as enrollment, staff, program, facilities and finances.

3. Transity studies - Models have been developed to show the effect of population movement. These are particularly helpful in facilities planning to eliminate locations which will be unusable in the future.

4. Bus scheduling models - Models have now been designed which provide for decision assistance as well as scheduling. Reduction of student waiting time, better bus utilization, more effective use of driver time, more effective maintenance scheduling, and many other items are the results of these models.

5. Support system analysis - Mathematical formulas for the analysis of the operating effectiveness of ancillary and auxiliary operations have been developed. To date, these formulas cannot identify a specific management problem, but they do indicate areas which need analysis. Bus operation costs; heating, power, and ventilating costs; custodial supply costs; and custodial and custodial and secretarial workloads are some examples of activities for which formulas have already been developed.

6. Program, planning, and budgeting systems - A number of projects are currently underway in PPB Systems. Because of the mass of data to be retrieved, stored, and analyzed, computers are essential to a PPBS operation. Evaluation of objectives through various means is being developed under a number of grant projects too numerous to enumerate.

Earlier reference was made to objective identification as the first function in the decision-making process. Initially in a system the computer will not help to identify possible objectives and courses of action - but as subsystems of the type just described are made available to your system you will find that they generate many possible alternatives and goals which you may not have previously considered.

What can you do

There are four basic questions that school administrators should ask themselves with regard to utilizing computers in the decision-making process:

1. Plan - What are our needs and objectives?

2. Quantify - What specific programs and activities will enable us to meet our objectives?

3. System Design - What action can we initiate to design a computer system before we acquire hardware?

4. Analyze Hardware - What hardware is available (lease, buy, time-sharing, etc) to assist us to obtain our objectives?)

In summary, computers can aid in the decision process through rapid calculation and feedback of information on probably consequences of decisions. Many more alternatives can be tested than were possible before. Planning can take place in a more timely and practical way, more people can participate simultaneously and directly in the decision processes, and because you are relieved of the burden of extensive manual calculations, more time is made available for innovative planning and management. You can become an agent of change rather than one who is changed!

IV. Comments of Panelists

A. Use of Computers to Aid the Decision System

Gary DeFrance, Business Manager,
Robbinsdale School District

In business and industry the term product mix is often used. To maximize profits many firms make extensive use of computers to simulate business activities and to test various assumptions and questions regarding their product mix. For example, what, when, where, and how to make a product and similar questions regarding the distributinos of a product.

Turning to education, in an attempt to maximize the return on the educational dollar, we might apply some of these techniques to our "curriculum mix":

What subjects should be taught:

By Whom?

For how long?

Where in a child's development should he be exposed to certain subjects?

Many more questions could be asked.

Decisions involving our "curriculum mix" are some of the most important ones facing education today. And here the computer makes its presence felt. Only with this tool can we conduct the research necessary to help us arrive at better decisions.

Harlan Sheely, Director, Information Systems
State Department of Education

Next to National Defense, education is the largest single enterprise in the United States. In 1967 expenditures for public education in Minnesota, including capitol outlay, approached 700 million dollars. Minnesota public schools enroll nearly 30 percent of the State's population. With nearly a million people and millions of dollars to be accounted for, the Minnesota educational enterprise appears ripe for the tasks that computers can uniquely perform.

With the aid of Federal funds, computer technology is becoming more evident in school and college classrooms across the nation. It was recently reported that the Office of Education has funded approximately $34 million on research and research-related activities, planning projects and operational programs which center around the application of new computer technology to educational problems.

Information problems are woven all through the fabric of the educational processes from problems of collecting, storing, communicating, retrieving, and displaying information to problems of receiving, learning and using information. Student, teacher, administrator, researcher, guidance worker, business manager and board member are all very directly concerned with the transmission and utilization of information. State and National attention is now focused on the strategic importance of education. The past decade and the past year has witnessed pressures in our schools of a kind and intensity not experienced before.

This pressure makes more evident the need for timely, accurate information concerning all aspects of the education process. So it is with the Minnesota State Department of Education.

The Department of Education is in the second year of a seven year effort to build a Management and Research Coordinated System (MARCS). It is an integrated system. An integrated system requires a predesigned relationship of the parts of the system. The system is being designed to collect data in its most elementary form. The computer is being used to compute relationships with a <u>minimum</u> manual effort and a <u>maximum</u> machine effort. MARCS will be compatible with the United States Office of Education and Midwestern States Education Information Project.

The primary objective of MARCS is to collect all relevant data once. Thus, substantially reducing the number of reporting documents and providing greater variability in retrieving information resulting in improved services to education agencies.

The Department of Education's entry to the Educational Data Processing Arena started in 1965. The need for responsive information which would reduce the reporting burden of L.E.A. directed our attention to the computer technology.

A survey of the information needs of the Department was concluded in July, 1965. The initial survey revealed the complexity of the Information Systems in use and provided for initial specifications for a more detailed system analysis.

The detailed analysis took nearly a year and involved four full time specialists from the ARIES Corporation. Their report of approximately 800 pages gave the Department a comprehensive picture of the solution to the reporting and informational problem.

The solution included an EDP design for 8 subsystems - Pupils, Finance, Personnel, Instructional Programs, and Facilities - these five have Regional and National compatibility. The School Lunch, Transportation, and RIMS (Rehabilitation Information Management System) are unique to this State.

Upon completion of the design two phases of implementation were initiated. The first phase included the establishment of five data committees, the necessary channels of communication, and an information dissemination program for Department personnel. Needless to say, considerable time and effort with great benefits were spent during this phase.

The second phase included planning, long and short term, allocating resources, staffing the physical implementation, the development of program specifications, programming, testing and debugging, form revision, and the necessary user information.

We have accomplished these steps to some degree in all eight subsystems. We have completed nearly all the steps in three. Currently, three subsystems are implemented statewide. School Lunch has been operational for several months. Personnel is in the final stages of data collection as is RIMS (Rehabilitation Information Management System).

Implementation of the Pupil Subsystem is underway. Present plans call for a parallel effort next year.

A brief review of the component parts may be helpful in understanding the nature of the venture. Time is of the essence this afternoon, therefore, the Pupil, Personnel, Instructional Programs, RIMS, and School Lunch Subsystems will be reviewed. MARCS is being designed to accept conventional reports, cards or magnetic tapes as inputs to the system. Considerable form consolidation will simplify reporting procedures.

Information about the pupil will be categorized and collected in the following pattern:

1. Census information will include the total number of children 0-20 years of age by school district and by age groups.

2. Fall or preliminary enrollment statistics by grade will be included which will be used for reports of current school year information.

3. Pupil data is to be collected on an individual pupil basis. Collecting Individual Pupil Data will facilitate many statistical reports and state aid calculations.

4. An Annual or Spring School Report will include Attendance and Enrollment information.

5. Summer Session reports for aid purposes are included in the subsystem as well, and will utilize many of the same Fall Assignment reporting documents.

The Personnel Subsystem deals with all professional personnel in schools - and has the facility for expansion as additional or new informational needs are defined.

The primary inputs to the system will be the teacher certification and the personnel assignment reports. Two main modules are created from these inputs, Personnel Qualifications and Personnel Assignments. These modules contain identification data, academic qualifications, current assignments, certification and recent employment data.

The Instructional Programs Subsystem is designed to provide data which will enable the S.D.E. to analyze the Educational Process. Because the Educational Process is dynamic it will be necessary to modify the reporting continuously as experience dictates and as new elements are related.

Curriculum offerings can be compiled from comprehensive personnel and instructional program reports. These reports will indicate what classes are taught, where, and by whom. This information will be used to aid in classification and evaluation of educational program.

The Rehabilitation Information Management Systems (RIMS) will not be related with the other subsystems directly as the activity does not relate as closely to school districts and pupils, but to clients and the rehabilitation programs. There are a number of significant outputs of the subsystem including the reports necessary to meet the Federal and State reporting requirements.

With data base provided in RIMS, an limited number of correlations and reports can be obtained. RIMS includes data about the client, authorization status, liquidation and counselor-vendor information.

The School Lunch Subsystem is also relatively free of standing in that it is not highly related with other subsystems. The subsystem involves extensive data handling in five major areas:

1. Entrance of participants in the Program

2. Monthly reimbursements

3. Commodity orders

4. Allocation of commodities and a

5. Commodity inventory.

Except for the accumulation of payments to the participant school's record in the Finance Subsystem, no other interaction is planned.

The benefits of such an undertaking are not immediate. It may appear to many that during the implementation considerably more information is being collected by the Department. In some cases this may be so. Obviously our collection procedures must be responsive to the changing and dynamic Educational Process. However, by consolidating information from several different forms to one form, it may appear that more information is being collected. When in the majority of cases this is not so. No significant benefit can be realized until MARCS is completely operational. During this transitional period we need the advice, counsel, and cooperation of all involved in this undertaking.

Tom Campbell, Director of Educational Services
Total Information for Educational Systems

Total Information for Educational Systems is a management information development. It was pointed out that the total information system may not be realized. We accept that. What we are attempting to develop is an integrated information system which may be total at any given point in time but certainly will never continue to be, as information and its uses grow.

Two of the objectives of an information system are to provide succinct and timely operative reports for each level of management and to collect data for planning purposes.

The operating reports are necessary to alert management to problems and difficult areas. These reports rely upon timing as an important element. Different management or decision levels have different information needs. Therefore, it would be incumbent upon us to provide management with the information appropriate to its needs to permit prompt action where and when needed.

Quality control and research are areas of operational reporting which can be improved through proper development of an information system in education.

The collection of data for long-range planning purposes is the second major objective of an information system. Census data, identification of resources being applied to individual programs, workloads and staffing patterns, revenue, and enrollments are all information utilized in planning in the educational environment. Besides storing and manipulating this data, the computer in the information system can help in establishing priorities in a school district and in providing local district information for state level planning. The total information system can provide the data for utilizing simulation in planning. By simulating an entire school system or simulating segments of curriculum and then altering the parameters "What if" decisions can be made quickly and the decision-maker can try on several solutions for size.

The development of an information system is expected to improve the kind and quality of information on which decision are made. Thereby, improving the kind and quality of decisions.

B. The Use of Computers in the Classroom

Dale LaFrenz, Mathematics Consultant
Total Information for Educational Systems

After investigating a number of projects involving the computer in instruction, I am willing to accept that the computer will have a significant effect on instruction. I assert that at this point in time it is impossible to predict what form of use of the computer will cause this effect. The best prediction would include all the current modes of use and many other modes as yet unknown.

Currently, instructional use of the computer breaks down into six major modes of use; 1) problem solving, 2) simulation, 3) tutorial, 4) drill and practice, 5) author, 6) computer science. Modes 1-5 all use the computer as a means of instruction. Mode 6 uses the computer as an object of instruction. There is nothing sacred about these classifications, but the terms are in common use.

In Minnesota problem solving has been the mode of major focus. Time sharing and a simple programming language called BASIC has allowed many Minnesota schools the opportunity to use a large scale computer in their instructional program. Preliminary efforts are being made by Minnesota educators to utilize the other modes of computer assisted instruction.

One thing for sure, it is the job of educators to determine the direction of the inevitable influences of the computer on instruction. Educators, and not computer vendors must show the way. If we don't, they will.

Robert M. Pesola, Computer Technology
Alexandria Area Vocational Technical School

The department of Computer Programming Technology was developed at the Alexandria Technical School during the fall of 1967. Its facilities now consist of a HONEYWELL series 200 computer with card, magnetic tape and magnetic disc capabilities. During the next thirty days, tele-communications will be added to this system utilizing two teletypes. One is to be installed in the local high school for class use in the math department in problem solving. The other teletype will be installed in our computer facilities for training purposes in programming, systems design and processing utilizing telecommunications. Two Honeywell key-tapes have now been installed for research in direct keyboard to tape input applications in both programming and processing.

Aims:

The major purpose of the computer center is to provide the best and most comprehensive computer training program for the student in the area. We presently have three instructors on our departmental staff. Each of these men possess years of experience and background in the data processing and computer areas. We have 22 second-year students still pursuing our two-year program and we began two new section of first-year students totaling 56 students. Training is provided utilizing three of the most popular languages used on computers along with heavy emphasis on systems design and development utilizing all four computer environments. Students work on real projects, in teams with assigned project leaders. Projects vary from surveys to complete accounting systems and will be heavily involved in the development of our CAI system.

Current Projects:

1. Implementation of complete student control system for the Technical School. This system is adaptable to any school system. It includes report cards, attendance control, administrative reports and reports and statistics for counseling and follow-up.

2. One team working on complete accounts receivable package.

3. Team is now assigned to work on Math software to implement communications for utilizing the computer for all math levels from grade seven on up through twelve. This may result in the development of our own simple language, if necessary.

4. Team assigned to work on a complete Farm Management system in conjunction with our Farm Management Department. Includes complete automatic farm accounting system, with statistical reports and future farm production projections and analysis.

5. Team working on a religious survey.

6. Team working on developing a complete census file to be used in obtaining school census using computerized methods.

Future Projects:

1. Doing research in the Science, Social Studies and Physics departments in utilizing computer assisted instruction, eventually to be used from grades 7 to 12. This includes the development and implementation of new methods and applications that are conducive to the small scale computer.

2. Research in utilizing the computer in conjunction with the department of Law Enforcement utilizing new methods in aiding the police officer.

3. Research in using CAI in developing better instruction for the Food Service department at the Technical School involving menu preparation and planning, food stock control, etc.

4. Implementation of full payroll system for the local school district, within the next year.

5. Establishing management games using CAI in conjunction with the Sales and Marketing department at the Technical School.

6. Many more smaller projects too numerous to mention.

Instructional uses of the computer have been under development for about 10 years now and much has been learned causing sizable changes in both philosophy and uses of the computer in the classroom from year to year.

We must all agree that this type of instruction is highly expensive. But we must also remind ourselves that anything newly developed or developing is always costly in some way or other. We cannot afford to let this computer media pass by and remain unused by the educational field. If education is going to keep up with the progress of technology and at the same level of that in the business and scientific worlds, we have no alternative. The computer is a must to maintain the level of education demanded by the employers of our product. It is a tool that none of us dare to ignore. We must learn to utilize it and improve upon its potential. Otherwise, the educational field will see our job taken over by industry itself and we have truly failed and the cost is unmeasurable.

Our situation is unique in that we possess the facilities and also programming personnel to do research in the educational areas. Since our prime objective is education, we are utilizing what we develop. The goal in Alexandria is to work toward this objective utilizing what we have on hand and make every effort to use the computer, not as a faster means of promoting old ideas, but as a tool to develop and implement new ideas in educating our student.

Arthur Lindberg, Assistant Professor of Mathematics,
Minnesota State College Board

We are all aware of the impact of computers on all aspects of modern life. We are today trying to assess that impact on education. One author says that education is still in the horse and buggy era while most other areas of our society are in the jet age. He goes on to cite experimental classes in which a computer was used to teach reading to a group of children behind their class because of a lack of basic reading skills. Within one year this group on the average surpassed the group from which they came in reading ability. Of course, when the computer was used with a normal group, their progress was phenomenal. In experimental classrooms across the country, the computer has been used and is being used to help the teacher teach basic skills. These experimental classes have been extremely successful in certain skill subjects such as: reading and arithmetic.

New York City has spent and is spending millions of dollars on computer hardware and computer professionals this year in order to bring CAI (computer assisted instruction) into its school system, particularly those elementary schools where the students are considered to be disadvantaged and which are behind in school work generally. I am sure that their investment will pay off and that these children will no longer be the disadvantaged.

In this day and age, a person who has not acquired the basic skills of reading, writing and arithmetic is very definitely handicapped. In Minnesota, we may feel quite smug; there are no extremely large segments of our population that are considered to be disadvantaged. We should not be! Large numbers of our students drop out of school each year mainly because they haven't acquired these basic skills to the degree that school work becomes enjoyable. Many of our college students fail for this same reason. They should be able to run and jump, but many are barely able to crawl when it comes to these basic skills of reading, writing and arithmetic. Therefore there is a very definite need for CAI throughout the school systems of Minnesota. Sooner or later, we will have CAI throughout the school systems of our state and the sooner the better.

So far I have been talking mainly in regard to CAI in the very lowest grades, but I am sure that the computer will become an integral part of the classroom experience at all levels and that in high school, a student should and will be able to elect four years of computer science much as he elects four years of mathematics now. I also believe that computer science is destined to become an important tool subject, second only in importance to English and mathematics.

Now to consider the main question: How much computer science should be required of prospective teachers? Obviously, the actual programming for CAI must be left to the computer professionals, but this does not mean that the teacher need know nothing of computers. He or she would still need to know the capabilities and limitations of the computer and know enough about it to overcome his or her fear of the unknown and be willing to make the most use of the computer as possible. For elementary school teachers a basic introductory course in computer science should be required. This course should include a study of off-line equipment such as sorters, collators, reproducers, etc. as well as on-line equipment, remote terminals and the computer itself. For junior high and high school teachers of math and science at least one full year or three courses in computer science should be required. The first of these should be a course in some higher level language such as fortran and should introduce numerical methods as they are needed; the second course should be a study of machine language and an assembly language; and the third course should include some of the mathematical foundations of computer science. And for teachers of computer science in high school, an undergraduate major should be required just as it is in most other subjects.

The hardware is available, but the cost is high; however, it isn't a question of, "Can we afford it?" but rather, "Can we afford not to support it?". State and federal support must be sought.

The hardware is available, but there is a very real shortage of computer professionals. In 1960, almost all of our math major graduates became teachers of mathematics. This year a large percentage of our math major graduates went into industry to become computer professionals. In 1961, the Mathematics Department of Mankato State College initiated three course in computer science. These were: (1) a course in fortran programming, (2)a course in machine language and assembler language programming and (3) a course in numerical analysis. These three courses were taught without the benefit of a computer until October, 1963, when the IBM 1620 was installed. The availability of the computer for instructions stimulated interest in computer science and we had to design, implement and teach five more courses in this area to satisfy student interest. Since that time, computer science has continued to grow and last year a committee was formed to study the relationship of our mathematics program to that of computer science. On recommendation from this committee, the mathematics department was divided into three distinct areas: Astronomy, Mathematics, and Computer Science. Requirements for majors and minors in computer science were formulated and now await final approval from the State College Board.

Although computer science is not required for a major in mathematics at Mankato State College, all our majors in mathematics do take at least one course in computer science and a very large number of them take two or more.

We are supplying industry, business and government with graduates knowledgeable on computers; we are producing teachers who are knowledgeable on computers. However, very few secondary schools offer course work in Computer Science. To stimulate use of the computer in high schools, Computer Services of Mankato State College in cooperation with the Edu-Culture Center of Mankato and the National Science Foundation, has set up a time share network to be used by six high schools in the vicinity of Mankato this coming school year. To summarize: Minnesota is backward in the use of computers in the classroom, but it is just a matter of time before

CAI becomes a reality at all levels of our public schools. For that reason, all teachers should be required to have at least one course in computer science, junior high and senior high teachers of math and science should have at least one year or three courses in computer science and teachers of computer science should have an undergraduate major in the subject.

Richard Hanson, Chairman, Math Department
Burnsville Senior High School

I react rather violently to the suggestion that all teachers be exposed to a lengthy course in machine-language programming (or even Fortran). This is a sure way to kill enthusiasm! There are many easy, conversational languages now available (such as BASIC) which will introduce the beast to the teacher, who can then USE it immediately.

I believe CAI is still a long way off...programmed texts can do the job as well as the expensive machine. The only way Pat Suppes can justify its use in drill and practice exercises is in a research setting. Schools should concentrate on CEI using the computer as a problem solving or simulation device, as a tool to strengthen concept learning, to study algorithmic design, to force the student to organize his material. The hardware and software for CEI is here now and the cost is not prohibitive for ANY school district. Let's get going, the equipment (teletypes, programmable calculators, etc.) will NOT be obsolete.

C. The Organization and Financing for Computers in Education

Jerry Foecke, Assistant Director
Total Information for Educational Systems

Hardware has advanced rapidly in recent years. New developments demand that we rethink our system developments and our entire approach to utilization of the computer.

Large random access and bulk storage devices now make it possible to store, retrieve and maintain large quantities of information on an efficient and effective basis.

...

Supportive hardware is becoming much more available. The recent emergence of less expensive tele-communications devices make possible several stations connected to a centralized computer.

Van Mueller, Professor of Educational Administration, University of Minnesota

...

Minnesota is in serious trouble in making provisions for regional or intermediate school district organization services to local school districts.

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Regional Labs (UMREL's counterparts) that have developed some computer services on a regional basis are: South West Development Lab in San Antonio, Texas (Dr. Joe Ward, Director), Central U.S. Regional Lab and the South West U.S. Regional Lab.

.....

Minnesota needs new legislation and a strong committment at the State level if services and advantages of the computer are to be made available for all children.

Bill Perry, Director, Data Processing, Iowa State Department of Education

The intermediate unit development in Iowa has been one motivated by several factors. One - the establishment of 16 area education districts by the State Department of Public Instruction several years ago to provide vehicle for vertical and horizontal communication with the local districts. No formal or legal structure was imposed upon the state, however geographical groupings of local school districts meet on a regular basis with an elected chairman who is a member of the coordinating committee and advisory council for the Improvement of Instruction in Iowa. This committee meets monthly in Des Moines at which time problems concerning State-Local relations are discussed.

Formal legislation enacted in 1965 allowed for the permissive merger of county school systems under the approval of the State Board of Public Instruction. At the present time, 15 counties have elected to merge into 5 separate Joint County Systems. These units are the prototype of the emerging intermediate education in Iowa.

The formation of the 15 Area Vocational Schools and Community Colleges in the past 4 years has also contributed to the area concept in Iowa.

Legislative efforts to bring about a mandated merger of county school systems have up to this time failed, however more and more counties are finding themselves hard-pressed with finances and available personnel to provide those services normally expected and demanded from the intermediate education unit. To answer these expectations and demands we are seeing many examples of joint employment of county superintendents, joint sponsorship of educational programs and other cooperative projects such as data processing services to schools.

At the present time we do have in operation in Iowa 3 area educational data processing centers. All of these have received impetus in some way or another from ESEA Title III monies, and one considerable support from MDTA, Vocational Education Act of 1963 and the area school legislation. These centers are providing in varying degrees many of the administrative data processing services discussed this morning as well as some of the instructional applications also discussed.

Two other area data processing centers are emerging at the present time, both of which will be (we hope) facing up to the task of financing and operation without the impact of federal or state funds. The State Department of Public Instruction is providing leadership through coordination and consultative services. Available to these emerging centers will be the expensive research and development of systems design and programming and experience of the centers funded by outside sources.

The Iowa Educational Information Center is an agency jointly sponsored by the State Department of Public Instruction, the University of Iowa and the Measurement Research Center. Now with a four-year history, the center has developed an educational data bank on a particular educational population which is, in my estimation, without equal in the world. Through the data collection system known as CardPac, the center has amassed characteristic data on the public secondary school students, staff, and curriculum in Iowa which can yield discriptions and analyses never before possible. The center is housed at the University of Iowa, Iowa City, and is headed by a 3-member board of directors permanently chaired by the State Superintendent of Public Instruction, Paul F. Johnston.

Under the direction of Dr. Ralph Van Dusseldorp, the center also provides many data processing services to the schools of Iowa. The objectives and resulting activities of the center are essentially those of the Department of Public Instruction and are quoted here to give an idea of where we are going in Iowa.

"Long Range Goals for Educational Information Systems in Iowa"

"The Iowa Educational Information Center believes that education in Iowa can be improved through intelligent use of data processing and computer techniques and the development and implementation of sound educational information systems.

"In order that education in Iowa may eventually receive the full benefits of data processing and computer technology, the Iowa Educational Information Center will work with other agencies including the State Department of Public Instruction, the State University of Iowa, other Iowa colleges and universities, public and private schools, elementary and secondary schools, public community colleges and area vocational schools, county education agencies, area education service centers, intermediate units, and professional education groups, toward the establishment of sound educational data processing and information systems in Iowa.

"It is not feasible for each Iowa school district to develop its own systems and procedures or to install its own data processing equipment. Nor is it feasible for a single central agency to provide complete data processing services to all the schools in the state. The Iowa Educational Information Center shall, therefore, encourage the establishment of regional centers which will provide data processing as well as other services to the local schools. These centers should serve the same geographic areas as the present area community colleges and area vocational schools.

"The Information Center should provide direct data processing services to local schools or area units only when this is the most feasible method for the schools or areas to secure the services. The systems used in the area centers should be compatible with the IEIC systems so that the Information Center can collect the information it needs concerning local schools from the area centers rather than directly from the local schools. The systems should also be such that the area centers can provide the Information Center and the State Department most of the needed information as part of their normal operating procedures. Part of the responsibility of the Information Center is to provide leadership in the establishment of area data processing services and the development of systems and procedures for these centers.

"The use of data processing computer equipment in education is not limited to information systems or the administration of education. This equipment will also be widely used for vocational education and education in mathematics and sciences and for computer assisted instruction. For efficient use of equipment, separate equipment should not be installed to serve each of these separate needs. Instead, area centers should consider all these needs and install the necessary equipment to serve them all.

"In order to serve the information needs of all educational agencies and to avoid wasted effort and duplication in information collection and processing, the Information Center will continue the development and operation of a data bank of educational information into which information concerning Iowa secondary education will flow from various sources and from which various agencies can obtain needed educational information."

Work is currently underway and should be completed soon on the policies, criteria and guidelines for the establishment of cooperative data processing centers in Iowa serving the local school districts and the Area Vocational Schools and Community Colleges. It is hoped that the policy statement will open the door to more effective and efficient use of education monies -- be it general or vocational -- to provide computer related services and instruction to all of the educational agencies in Iowa.

We in education have established and demonstrated a need for educational data processing. We have heard it discussed quite openly in this conference. I would hope that the future will bring to education those benefits of the computer that Industry has long enjoyed. Creative and imaginative action must be initiated by educators in applications and financing to bring this into reality.

We are proud of what we have done in Iowa, but realize how far we have to go. If any of you would care to have more information concerning our centers or would like to visit specitif operations, please feel free to contact me.

Fred M. Atkinson, Superintendent of Schools
Bloomington, Minnesota

Advantages for cooperative efforts in providing computer services:

1. Pooling of resources results in a more efficient and effective operation. More expertise can be assembled.

2. The response to districts needs was not always available on a commercial basis.

3. The cooperative joint boards are more responsive to needs of districts.

4. It provides for a broader base for research.

Disadvantages for cooperative efforts in providing computer services:

1. It takes time and effort to coordinate several districts.

2. Joint boards are cumbersome. We need a different type of legal entity than presently exists in Minnesota.

3. Some services are less personalized.

Dick Wollin, Director, ERDC
Southwest Minnesota

Reinforcement of the regional committment emphasized by the other speakers. The smaller rural school district has no other potential for achieving the benefits of an adequate computer operation.

Southwest State College at Marshall does have a committment of community and local school district service. If the college can play a role in the computer services area, it might become a factor in this service area.

Frank Verbrugge, Director, Office of Computing Activities
University of Minnesota

Computing in a modern sense is a very recent origin; it is also unique in its rate of change and growth. Much of its early needs and its early development arose in the area of scientific and engineering research. It is not surprising, therefore, that many design considerations have reflected this orientation. More recently, the extraordinary data processing and memory capacities of computers have stimulated wide usage in the business community, both as instruments for data processing and in design making. In many respects these two streams of development are beginning to merge and computers as general purpose machines have arrived. Even so, optimal usage of a machine for scientific research purposes implies design considerations different from those which are used for data processing, for information processing or for instructional purposes.

Until recently, far and away the largest amount of direct computing support arose through federal agencies. The computer industry itself participated primarily through educational discounts and special contractual agreements. Among the mission-oriented agencies, the Atomic Energy Commission and the National Institutes of Health have been major sources for funding, though other agencies such as NASA and the several agencies in the Department of Defense have also provided support. To a large extent, the support by the various federal agencies was for special purpose facilities in individual research laboratories -- for example, in nuclear physics or in the several bio-medical fields. Only recently have major efforts at a coordinated development become a major element in university policy. Similarly, only in the past four or five years have general agencies such as the National Science Foundation and Office of Education become major participants in computer funding.

It may be useful to you to relate our progress at the University very briefly. The first general purpose computer purchased by the University was a Univac 1103, purchased in 1958. Its capability was soon saturated. It was therefore replaced by a CDC 1604 in 1962. The purchase of this computer was made possible by a grant from the National Science Foundation and an appropriation from the Minnesota legislature. Because computer usage at universities has had a pattern of doubling annually, the CDC 1604 rapidly extended its work schedule and by 1965 was operating on a 24-hour day basis, 6 or 7 days per week. At that time plans were made to procure a third generation machine. The decision was made to order a CDC 6600 which has a capability approximately twenty times that of the 1604. At that time, also, the long-range configuration of the university's computer network was agreed upon. This involves the use of remote input-output stations, either with or without a remote computer capability. To date, three such remote terminals have been established: an import-export station in the science and engineering complex on the East bank, a CDC 3200 computer on the West bank for the School of Business Administration and the Social Sciences, and a CDC 3300 for the College of Medical Sciences. The 6600 itself is located approximately three miles from the university campus and is connected to remote terminals through broad-band communication links.

The CDC 1604 is now used almost entirely for student computations. Far and away the largest number of these students are undergraduates who use the computer for problem solving in connection with one or more of their courses. In a typical day, approximately 1000 such computations are made. The 6600 system is used largely for research purposes. Approximately 600 individual research grants and contracts at the University maintain accounts with the computer center. For many of these, of course, many computations will be made in a typical month.

Separate from the systems described above, the University maintains a computing center for its business office. Also, many special purpose computers are located in a number of locations on campus and serve a variety of functions:

1. Data processing and control functions for research laboratory equipment: One such example is a computer which serves as a processing and control device for the tandem accelerator in the School of Physics.

2. Educational Research: One such example is the computer in the Center for Human Learning, where studies of the learning interaction between man and the computer is being studied.

3. Library Systems: Data on the collections in the Bio-Medical Library are in the process of being stored in computer compatible form. At some time in the future, we expect that both the inventory and circulation functions can be computer controlled. We also look upon it as a pilot model for more general developments in modernization of the University's library.

During the past two years the University has made increasing use of time-sharing consoles for instructional purposes. A typical user sits at the terminal for approximately 10-15 minutes to submit his program, to modify it and receive a printback. That is to say, some 4 or 5 customers can use a terminal each hour. The major motivation is that of providing students with a direct laboratory experience in the use of computers. The programming and computation rate for a given problem is generally much slower than that of the batch processing mode. That is, the "connect time" is much higher and its cost proportionately higher. One result will likely be that, in major institutions, many student computations will continue to be done on a batch processing rather than on a time-sharing basis.

Let me now state a few general considerations which may be relevant for any institution in the process of developing a computer capability.

1. Historically and continuing into the present, there has been an advantage to large systems from the point of view of computations done per dollar of computer costs, that is, throughput per dollar of investment. This factor tends to be about 10 for computers in the cost range of $\$10^5$ and a multi-million dollar computer. Prior to any acquisition, a detailed analysis of cost versus a computer capability is essential.

2. For small and medium size institutions, it may well be that computational output is not a primary consideration. Multiple purpose usage, flexibility, and budgetary limitations below that required for a medium-sized computer may well be determinative. Small computers with relatively high processing speeds are available, though they do have limitations both as to memory size and sophistication of programming. Alternative approaches include the use of consoles connected on a time-sharing basis, to an external computer; and remote batch processing and time-sharing on a computer serving several.

3. At one time the investment in computer hardware was perhaps the single most important cost factor. At the present time, the development of programs compatible with the computer and the costs associated with staffing tend to predominate. For example, as a rule of thumb, some 4-5 years ago, operational costs were approximately equal to annual capital acquisitions costs; that is, one-half of the total annual cost. At the present time, however, operational costs tend to be come 2/3 to 3/4 of the total annual cost.

4. The increasing software and staff costs for computing have implications, also, for the lifetime of a computer system. As recently as 3 or 4 years ago, the rapidly declining costs of computer hardware versus computer throughput was the single most important factor in the rapid turnover of computing facilities. The relatively high operating costs will likely mean that computers will not be replaced in the future as rapidly in the past. In fact, the day may arrive when machines will be used until they are abandoned, rather than until they are replaced.

5. The expectation of a longer lifetime also means that it will be increasingly more attractive to purchase computers rather than to lease them. The typical annual lease rate is approximately 1/5 or 1/4 of the purchase price. The longer life expectancy will therefore make purchasing more attractive. It should be pointed out that with the purchase agreement, the maintenance costs become the responsibility of the customer.

6. I have already commented both on the advantages, the educational uses and the relative costs of the time-sharing consoles. Consoles can provide an attractive medium for simple computations on the part of relatively large numbers of students. We have already commented that a remote batch processing system can have an "effective computational rate" some 20-50 times as great. It also should be recognized that there can be relatively severe limitations on the problem size when using a time-sharing console. An available memory of, say, 400 16-bit words may be adequate for many problems to be solved by an undergraduate student. It is not likely to be adequate for many problems of an engineering nature, or for research problems of a staff member.

The same kind of considerations which I have outlined here could apply equally well to a computing system that serves more than one institution. In the future, it will prove less and less feasible to purchase a separate computer for each anticipated use. However, a large regional computer complex using one or more machines to handle all computational work, and all data and information processing for a group of institutions in a region, would likely create more problems than it solves. The development of an integrated system consisting of sub-systems serving one or more purposes offers the best prospects for getting the most for one's dollar. For such a complex, it is essential that careful planning be done before decisions are made as to the hardware and its regional configuration.

APPENDIX B

A Status Report on Electronic Data Processing in Education in Minnesota

A STATUS REPORT ON ELECTRONIC DATA
PROCESSING IN EDUCATION IN MINNESOTA

Gerald L. Ericksen

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I. Introduction

This survey was conducted in an effort to determine the present status of educational data processing efforts in the State of Minnesota. The survey was organized as follows: Elementary/Secondary Public School Districts, Vocational Technical Schools, State Junior Colleges, State College System, Private Colleges, University of Minnesota, Agencies and Private Firms. The report is a summary of the returns of the questionnaires included in Appendix D together with additional information provided by the above institutions and organizations.

The information was gathered for the benefit of the Minnesota Council and Educational Information Systems (M.C.E.I.S.). While all educational institutions in the state were contacted, not all responded and therefore there may be some omissions. Nevertheless, it is felt that these results present a fairly comprehensive picture of the type of data processing efforts being undertaken in the various educational institutions and related agencies in Minnesota.

II. Elementary/Secondary School Districts

The public school districts seem to divide themselves into two categories as far as their major data processing efforts are concerned: Those connected with the T.I.E.S. project and others.

The T.I.E.S. organization (Total Information for Educational Systems) is formally known as the Minnesota School Districts Data Processing Joint Board located at 555 Wabasha Street, Room 301, St. Paul, Minnesota.

There are presently 22 school districts scheduled to utilize the T.I.E.S. system, of which 20 responded to this survey. The T.I.E.S. system will employ a Burroughs 3500 computer system. Apparently, as seen from Table 1, while all 22 districts will use the T.I.E.S system in some capacity the utilization will not be uniform throughout all schools.

TABLE I

QUESTIONNAIRE SUMMARY FOR ELEMENTARY AND SECONDARY SCHOOLS

A. Administrative Applications

1. General Business Office Accounting	Presently Handled by E.D.P.	Presently Planned for E.D.P.	Type of System (If located in School System)	Name of Outside Agency Providing E.D.P. Services (If equipment is not located in School System
General Ledger		10	Telephone Data link to	TIES
		1	IBM 1620	
		1		IBM
	2		IBM 1401 Disk	
	1		IBM 1440	
	1			Scientific Computers
	1			Sexton-Harmon
Budgeting		15	Tel phone Data Link to	TIES
		1	IBM 360/25 Disk	
		1	IBM 1620	
		1	IBM (not specified)	
		1	Unit Record	
	1			Scientific Computer
	1			Sexton-Harmon
	1			IBM
	1		IBM 1401	

	Presently Handled by E.D.P.	Presently Planned for E.D.P.	Type of System (If located in School System)	Name of Outside Agency Providing E.D.P. Services (If equipment is not located in School System
Payroll		16	Telephone Data Link	TIES
		1	IBM 1620	
		1		IBM
	3			Service Bureau Corporation
	1			Marquette Natl's Bank
	2			Ramsey County Data Processing
	1			Scientific Computers
	1			Mankato Service Bureau &
	2		Unit Record	Northwestern Nat'l Bank
	2		IBM 1401 Disk	
	1		IBM 1440	
	1		IBM (not specified)	
Purchasing		5	Telephone Data Link to	TIES
		1	IBM 360 Disk	
		1	IBM 1620	
		1	IBM (not specified)	
	1			Scientific Computers
	1		IBM 1440	
	1		IBM 1401	
Extraclassroom Activity Accounting		7	Telephone Data Link	TIES
		1	IBM 1620	
	1			Scientific Computers
	1		IBM 1401	

	Presently Handled by E.D.P.	Presently Planned for E.D.P.	Type of System (If located in School System)	Name of Outside Agency Providing E.D.P. Services (If equipment is not located in School System)
Transportation Requirements		12	Telephone Data Link	TIES
		1	IBM 360 Disk	
		1	IBM 1620	
	1			Scientific Computers
Supplies and Inventory		15	Telephone Data Link	TIES
		2	Unit Record	
		1	IBM 360 Disk	
		1	IBM 1620	
		1	IBM (not specified)	
	1			Scientific Computers
	1		Unit Record	
	1		Brainerd Voc. School	
	1		IBM 1401	
Accounts Payable and Receiveable		16	Telephone Data Link	TIES
		1	IBM 360 Disk	
		1	IBM 1620	
		1	IBM (not specified)	
		1	Unit Record	
	1			Scientific Computers
	1			IBM
	1			County
	1		IBM 1401	
	1		IBM 1440	
	1		Unit Record	

	Presently Handled by E.D.P.	Presently Planned for E.D.P.	Type of System (If located in School System)	Name of Outside Agency Providing E.D.P. Services (If equipment is not located in School System)
School Insurance		3	Telephone Data Link to	TIES
	1			Scientific Computers
	1		Unit Record	
Maintenance		4	Telephone Data Link	TIES
		1	IBM 1620	
	1			Scientific Computers
	1		IBM 1401	
	1		IBM 1440	
Salary Simulation		1	Telephone Data Link	TIES
State & Federal Reports		1	Telephone Data Link	TIES
Lunch Program	1			State Dept. of Education
Expense Analysis & Monthly Receipts	1			County
Annual Financial Statement	1			County
Federal Accounting		1	IBM (not specified)	

	Presently Handled by E.D.P.	Presently Planned for E.D.P.	Type of System (If located in School System)	Name of Outside Agency Providing E.D.P. Services (If equipment is not located in School System)
Student Census Data		16	Telephone Data Link	TIES
		2	IBM 360/25	
		1	IBM 1620	
	1			Ramsey County Data Processing
	2			Service Bureau Corporation
	1			Scientific Computers
	2		Unit Record	
Transcripts		14	Telephone Data Link	TIES
		1	IBM 1401 Disk	
		1	IBM 1620	
		1	Unit Record	
	1			Brainerd Data Service
	1		IBM 1401 Disk	
Class Lists		15	Telephone Data Link to	TIES
		1		Data Management, Inc.
			IBM (not specified)	
		1	IBM 402	
	8			Data Management, Inc.
	3			Measurement Research Center
	2			Service Bureau Corporation
	1			Pillsbury
	1			IBM 1401 (rented)
	1			Educational Coordinating, Palo Alto, California

	Presently Handled by E.D.P.	Presently Planned for E.D.P.	Type of System (If located in School System)	Name of Outside Agency Providing E.D.P. Services (If equipment is not located in School System)
Census		1	Unit Record	
W2	1		Unit Record	
Tax Reports	1		Unit Record	
2. Personnel Accounting				
(Pension, Retirement, Job Evaluation, etc.)		13	Telephone Data Lank to	TIES
		1	IBM 1620	
		2	Unit Record	
	2		IBM 1401 Disk	
	1		Unit Record	
3. Student Records				
School Directory		4	Telephone Data Link	TIES
		2	IBM Unit Record	
		1	IBM 1401 Disk	
		1	IBM 1620	
	1			Data Management, Inc.
	2			Measurement Research Center
	1			Pillsbury
	2		IBM 1401 Disk	
	1		IBM 360 (rental)	

	Presently Handled by E.D.P.	Presently Planned for E.D.P.	Type of System (If located in School System)	Name of Outside Agency Providing E.D.P. Services (If equipment is not located in School System)
Class Lists (contd)	1			Brainerd, Data Service
	1			AIM, Inc. (Minneapolis)
	1			IBM
	1			Univ. of Minn. - Duluth
	3		IBM 402	
	2		IBM 1401	
	1		IBM 1440	
	1		IBM 1620	
	1		IBM 360 (rented)	
Class Sectioning		13	Telephone Data Link	TIES
		2	IBM (not specified)	
		1		Data Management, Inc.
	7			Data Management, Inc.
	3			Measurement Research Center
	3			Service Bureau Corporation
	1			IBM 360
	1			Pillsbury
	1			Univ. of Minn. - Duluth
	1			IBM 1401 (rented)
	1			Educational Coordinating, Palo Alto, California
	1			Brainerd Data Service
	1			IBM 1401 & 7070 (rented)
	1			AIM, Inc.
	1			IBM
	1		Unit Record &	Univ. of Minn. - Duluth, & May Clinic & N.S.P. (Mpls).
	1		IBM 1440	
	1		IBM 1401	
	1		IBM 1620	

	Presently Handled by E.D.P.	Presently Planned for E.D.P.	Type of System (If located in School System)	Name of Outside Agency Providing E.D.P. Services (If equipment is not located in School System)
Grade Reporting or Analysis		16	Telephone Data Link to	TIES
		2	IBM (not specified)	
		1		Data Management, Inc.
	8			Data Management, Inc.
	3			Service Bureau Corp.
	1			IBM 360
	1			Measurement Research Center
	1			Scientific Computers
	1			Pillsbury
	1			IBM 1401 (rented)
	1			Brainerd Data Service
	1			Univ. of Minn. - Duluth
	1		IBM 1620 (rented)	
	1		IBM 1440	
	2		IBM 1401	
	1		IBM 1620	
	2		Unit Record	
Test Scoring or Analysis		15	Telephone Data Link	TIES
		1	IBM 360/25	
		1	IBM 1620	
		1		Univ. of Minn. - Duluth
		1		U of M - Houghton-Miflin Co.
	1			Various agencies
	1			Test Agencies
	1			Measurement Research Center
	1			University of Iowa
	4			U of M - Houghton-Miflin Co.
	1		IBM 1440	
	1		Datronics 500	

	Presently Handled by E.D.P.	Presently Planned for E.D.P.	Type of System (If located in School System)	Name of Outside Agency Providing E.D.P. Services (If equipment is not located in School System)
College Admission Records		2	Telephone Data Link	TIES
		1	IBM 1620	
	1			Test Agencies
	1		IBM 1401	
Library Circulation Control		6	Telephone Data Link	TIES
		2	IBM 402	
Attendance		9	Telephone Data Link to	TIES
		1		Univ of Minn. - Duluth
		1		Data Management, Inc.
		1	IBM 360 (rented)	
		1	IBM 402	
	3			Data Management, Inc.
	3			Service Bureau Corp.
	2			Measurement Research Center
	2		IBM 402	
	1		IBM 1401	
	1		IBM 1440	
	1		IBM 1620	
	1		IBM 360 (rented)	
	1			IBM 1401 (rented)
Misconduct Reports and Analysis		1		U. of Minn. - Duluth

	Presently Handled by E.D.P.	Presently Planned for E.D.P.	Type of System (If located in School System)	Name of Outside Agency Providing E.D.P. Services (If equipment is not located in School System
Athletic Tickets and Accounting		2	Telephone Data Link	TIES
		1	IBM 1620	
		1		Univ of Minn - Duluth
Identification Cards	1			Measurement Research Center
Health and Dental Records		3	Telephone Data Link	TIES
		1		Univ of Minn - Duluth
	1		IBM 1401	
Honor Roll		12	Telephone Data Link	TIES
		1		Univ of Minn - Duluth
		1		Data Management, Inc.
		1	IBM 360 (rented)	
		1	IBM 1402	
	6			Data Management, Inc.
	2			Measurement Research Center
	2			Service Bureau Corp.
	1			IBM 1401 (rented)
	1			U of M - Houghton-Miflin Co.
	1		IBM 1440	
	2		IBM 1401	
	1		IBM 360 (rented)	
	1		IBM 402	

	Presently Handled by E.D.P.	Presently Planned for E.D.P.	Type of System (If located in School System)	Name of Outside Agency Providing E.D.P. Services (If equipment is not Located in School System)
Locker Assignments		1	Telephone Data Link to	TIES
		2	IBM (not specified)	
		1		Univ of Minn - Duluth
	2		Unit Record	
Mailing Labels		1	Telephone Data Link	TIES
Modular Scheduling	2			University of Iowa

B. Instructional Applications	Subject - Matter	Presently Handled by E.D.P.	Presently Planned for E.D.P.	Type of System (If located in School System	Name of Outside Agency Providing E.D.P. Services (If equipment is not located in School System
1. Computer-Assisted Instruction in the Classroom	Math, Science Soc. Studies		16	Telephone Data Link to	TIES
			5	Dial-A-Computer	Pillsbury
	Elem. Full Curriculum		1	IBM 360/25	
	Math		1		Control Data
(Simulation, Tutorial, Drill & Practice, Information Retrevial, Computer Based Teaching Machine, Stimulus Sequencing, etc.)			1		IBM 360 (rented)
	Bus Ed, Data Proc.		1	IBM 402	
			1		WANG Laboratory
		4		Dial-A-Computer	Pillsbury
	Math & Comm	2		IBM 1620	
		1		Mobile	Pillsbury
	Math	1			St. John's University

	Subject-Matter	Presently Handled by E.D.P.	Presently Planned for E.D.P.	Type of System (If located in School System)	Name of Outside Agency Providing E.D.P. Services (If equipment is not located in School System)
1. Computer-Assisted Instruction in the Classroom (Con't)	Math	1			Control Data
	Math & Bus Ed	1		Bendix G-15	
	Reading Talking Type.	2 centers		Edison Responsive Environ, Corp.	
2. Used as a Computing Aid in Problem Solving	Math Science		17	Telephone Data Link to	TIES
			2	Dial-A-Computer	Pillsbury
	Math Soc. St., Commercial		1	IBM 1620	
	Math		1		Control Data
Student/Faculty Research, Class Assigned Problems, etc.)		6		Dial-A-Computer	Pillsbury
	Math 12	1			Univ. of Minnesota
	Math & Bus Ed	1		Bendix G-15	
3. Training in E.D.P. Programming (separate course)			7	Telephone Data Link	TIES
	Math		2		Control Data
			1		IBM 360 (rental)
	Math	2		IBM 1620	
		1		IBM 1401	

	Subject Matter	Presently Handled by E.D.P.	Presently Planned for E.D.P.	Type of System (If locsated in School System)	Name of Outside Agency Providing E.D.P. Services (If equipment is not located in School System)
Programming (Unit in Existing Course)	Math		5	Telephone Data Link	TIES
			2	Dial-A-Computer	Pillsbury
		4		Dial-A-Computer	Pillsbury
		1			Control Data
		1		IBM 1620	
		1		IBM 1401	
	Tab. Tech.	1		Brainerd Voc. Sch.	
	Higher Math	1		Bendix G-15	
	Jr. High Math	1			Control Data
		1		Unit Record	
Keypunching	Voc Sch		1	Telephone Data Link to	TIES
	Bus Ed		1	IBM 407	
	Math and Bus Ed		1	IBM (rental)	
	Bus Ed		1	IBM 026	
			2	Unit Record	
	Data Proc.		2	IBM (not specified)	
			1	Own Keypunches	
	Business	1(theory)		3M Materials	
		1		Unit Record	
	Bus Ed	1		IBM 407	
	Math and Bus Ed	1		IBM (rental)	
	Bus Ed	1		IBM 026	
		2		Unit Record	
		1			IBM 026 (Bus Depot)
		2		IBM (not specified)	
		1		Own Keypunches	
	Sec Train	1		Brainerd Voc School	
	Math & Comm	1	—	IBM 1620	
	Data Proc	1		IBM (not specified)	

	Subject Matter	Presently Handled by E.D.P.	Presently Planned for E.D.P.	Type of System (If located in School System)	Name of Outside Agency Providing E.D.P. Services (If equipment is not located in School System)
Wiring	Voc. Sch		1	Telephone Data Link	TIES
Unit	Data Proc		3	IBM 402	
Record			1	IBM 407	
Equip.		2		IBM 1401	Area Vocational School
	Data Proc	2		IBM 402	
		1		Unit Record	
	Tab Tech	1		Brainerd Voc Sch	
		1		IBM 1620	
Tabulating	Voc Sch		1	Telephone Data Link	TIES
Equipment	Vus Ed		1	Unit Record	
Operator			1	Unit Record	
	Tab Tech	1		Brainerd Voc Sch	
		1		IBM 1401	
		1		Own IBM	
		1		IBM 1620	
		1		Unit Record	
Elementary Programming		1			Control Data
Project on Student Test Data					Willmar ERDC
Hands-Off Orientation Course for E.D.P.					3M
Data Processing Elective Class for Juniors and Seniors	Data Proc.				

III. Vocational Technical Schools

A. Public

Several of Minnesota's Area Vocational Technical Schools offer training for data processing personnel, tabulating technicians or computer maintenance.

The bulletin of the Minnesota Department of Education (Code XXXVII-A-1) for 1967-68 lists the schools given in Table 2 as providing training in this area.

Table 2

Minnesota Area Vocational Technical Schools

Vernon Maack, Director	Alexandria, Minnesota
Morton A. Carney, Director	Austin, Minnesota
E. M. Outwin, Director	Bemidji, Minnesota
Harry Nysather, Director	Brainerd, Minnesota
Robert Bergstrom, Director	Duluth, Minnesota
Ray Freund, Director	Faribault, Minnesota
William Magajna, Director	Hibbing, Minnesota
Frank G. Kalin, Director	Mankato, Minnesota
Raymond V. Nord, Director	Minneapolis, Minnesota
Oscar Bergos, Director	Moorhead, Minnesota
James C. Wakefield, Director	St. Cloud, Minnesota
Harold M. Ostrem, Director	St. Paul, Minnesota
Donald C. Hammerlinck, Director	Wadena, Minnesota
Michael Cullen, Director	Willmar, Minnesota
Thomas W. Raine, Director	Winona, Minnesota

B. Private

Table 3 lists some area private schools and training institutes that offer computer and/or data processing related training. These institutions were selected from those training schools registered and bonded under the office of the Secretary of State of Minnesota.

Table 3

Schools Registered and Bonded under the Office of the Secretary of State of Minnesota

Correspondence Schools	Training Offered
Automation Training St. Louis, Missouri	Automatic Data Process.
Midwest Automation Training Kansas City, Missouri	IBM Data Processing
Capitol Radio & Engineering Institute Washington, D. C.	Electronics, Data Processing
Metropolitan College of Business & Technology Milwaukee, Wisconsin	IBM, Keypunch Data Processing
Combination Correspondence & Resident Schools	
DeVry Technical Institute Chicago, Illinois	Programming & Analog Computers
Gale Institute Minneapolis, Minnesota	Data Processing
Resident Schools	
Brown Institute of Broadcasting & Electronics Minneapolis, Minnesota	Data Processing
Control Data Institute Minneapolis, Minnesota	Electronics Data Processing
Electronics Computer Programming Institute Minneapolis, Minnesota	Computer Programm.
Mankato Commercial College Mankato, Minnesota	Data Processing & Programming
Minneapolis Business College Minneapolis, Minnesota	Data Processing
Minnesota School of Business Minneapolis, Minnesota	Data Processing

Minnesota Technical Institute Duluth, Minnesota	Data Processing
Northwestern Electronics Institute Minneapolis, Minnesota	Data Processing
Programming & Systems Institute Minneapolis, Minnesota	Computer Program
School of Automation Des Moines, Iowa	Automatic Data Processing

IV. State Junior Colleges

Anoka Ramsey State Junior College
Austin State Junior College
Brainerd State Junior College
Fergus Falls State Junior College
Mesabi State Junior College
Metropolitan State Junior College
North Hennepin State Junior College
Northland State Junior College
Rochester State Junior College
Vermilion State Junior College
Willmar State Junior College

Of the 16 Junior Colleges associated with the Minnesota Junior College Board only Lakewood Junior College of White Bear Lake has computer facilities or extensive course offering (37 credits) in Data Processing or Systems Analysis. The Lakewood facility includes Unit Record Equipment as well as an IBM 1401 with two Disk Drives. This equipment is utilized for training, administrative work (including pupil accounting).

In addition, Lakewood Junior College provides several centralized data processing services for other State Junior Colleges as shown in Table 4.

Table 4

QUESTIONNAIRE SUMMARY FOR MINNESOTA STATE JUNIOR COLLEGES

I. Administrative Applications A. General Business Office Accounting	Presently Handled by E.D.P.	Presently Planned For E.D.P.	Type of System (If located in School)	Name of Outside Agency Providing E.D.P. Services (If equipment is not located in school)
1. General Ledger	4			Lakewood Jr. College
		1		Lakewood Jr. College
a. Budgeting	2			Lakewood Jr. College
		2		Lakewood Jr. College
b. Payroll	4			Lakewood Jr. College
	2			State of Minnesota
	1		360/40	Dept of Administration
c. Purchasing	2			Lakewood Jr. College
		1		Lakewood Jr. College
d. Supplies and Inventory	1			Lakewood Jr. College
		2		Lakewood Jr. College
e. Accounts Payable or Receivable	3		IBM 1401	Lakewood Jr. College
	2			State of Minnesota
		1		Lakewood Jr. College
f. School Insurance	1			State of Minnesota
	1			Blue Cross
g. General Mailing Lists	1		IBM 1401	Lakewood Jr. College
h. Alumni File		2		Lakewood Jr. College
i. Financial Aid	1			ACT - Iowa City, Iowa
		2		Lakewood Jr. College

	Presently Handled by E.D.P.	Presently Planned for E.D.P.	Type of System (If located in School)	Name of Outside Agency Providing E.D.P. Services (If equipment is not located in school)
2. Personnel Accounting	2			State of Minnesota
	2			Lakewood Jr. College
(Pension, Retirement, Job Evaluation, etc.)		1		Lakewood Jr. College
3. Student Records				
a. School Directory	1		IBM 1401	Lakewood Jr. College
		7		Lakewood Jr. College
b. Student Census Data	2			Lakewood Jr. College
		7		Lakewood Jr. College
c. Transcripts	4			Lakewood Jr. College
		6		Lakewood Jr. College
d. Class Lists	5			Lakewood Jr. College
		5		Lakewood Jr. College
e. Class Scheduling	2			Lakewood Jr. College
		5		Lakewood Jr. College
f. Class Sectioning	3			Lakewood Jr. College
		6		Lakewood Jr. College
g. Grade Reporting or Analysis	5			Lakewood Jr. College
		5		Lakewood Jr. College
h. Test Scoring or Analysis	-	4		Lakewood Jr. College
i. College Admission Records	2			Lakewood Jr. College
		3		Lakewood Jr. College

	Presently Handled by E.D.P.	Presently Planned for E.D.P.	Type of System (If locayed in School)	Name of Outside Agency Providing E.D.P. Services (If equipment is not located in School)
II. Instructional Applications				
A. Computer-Assisted Instruction in the Classroom			NONE	
B. Used as a Computing Aid in Problem Solving				
Faculty/Administration Research	1			Lakewood Jr. College
Class Assigned Probelms		1	IBM 1401	Lakewood Jr. College
III. Data Processing Courses Offered				
A. Introduction to Data Processing	1			Olmsted County

V. State College System

Mankato State College
Moorhead State College
St. Cloud State College
Southwest Minnesota State College
Winona State College

Table 5 summarizes the questionnaire responses for the Minnesota State Colleges.

Table 5

QUESTIONNAIRE SUMMARY FOR MINNESTOA STATE COLLEGES

I. Administrative Applications A. General Business Office Accounting	Presently Handled by E.D.P.	Presently Planned for E.D.P.	Type of System (If located in School)	Name of Outside Agency Providing E.D.P. Services (If equipment is not located in School)
1. General Ledger		1	Unit Record (IBM 1130 & 407)	
a. General Budgeting		1		
		2	Unit Record (IBM 1130 & 407)	
b. Payroll	1		IBM 1401	
	1			State of Minnesota
		1	IBM 1401	
		1(partial)	IBM 1130 & 407	
c. Purchasing		1(partial)	IBM 1130	
		1	IBM 1130	
		1	IBM 1401	
d. Supplies & Inventory		1	IBM 1130 & 407	
		1	IBM 1130	
		1	IBM 1401	
e. Accounts Payable or Receivable	1		IBM 1401	
		2	IBM 1130	
f. General Mailing Lists	1		IBM 1401	
	1		IBM 407	
		1	IBM 1130	
g. Gift Record Accounting		1		
		2	IBM 1130	
h. Alumni File	1		IBM 1401	
		1	IBM 1401	
		2	IBM 1130	—
			IBM 1401	

	Presently Handled by E.D.P.	Presently Planned for E.D.P.	Type of System (If located in School)	Name of Outside Agency Providing E.D.P. Services (If equipment is not located in School)
1. General Ledger (cont'd)				
i. Dormatory Records	2		IBM 1401	
		1	Unit Record (IBM 407)	
		1	IBM 1130	
j. Financial Aid	2		IBM 1401	
	1		IBM 1620	
		1		
		1	IBM 1130	
k. Bookstore		1(partial)	IBM 1401	
2. Personnel Accounting				
(Pension, Retirement,	1(partial)		IBM 407	
Job Evaluation, etc.)	1			State of Minnesota
3. Student Records				
a. School Directory	2		IBM 1130	
	1		IBM 407	
	1		IBM 1401	
b. Student Census Data	2		IBM 1401	
	1		IBM 407	
	1		IBM 1130	
c. Transcripts	2		IBM 407	
	1		IBM 1401	
		1	IBM 1130	

d. Class Lists	2		IBM 1401
	1		IBM 1620
	1		IBM 407
		1	IBM 1130
e. Class Scheduling	1		IBM 1620 & 1401
	1		IBM 1401
		1	IBM 1130
f. Class Sectioning	1(trial)		IBM 1620 & 1401
	1		IBM 407
		1(partial)	IBM 1130
g. Grade Reporting or Analysis	2		IBM 1401
	1		IBM 1620
	1		IBM 1130
	1		IBM 407
h. Test Scoring or Analysis	2		IBM 1401
	1		IBM 1620 & 519
	1		IBM 1230
		1	IBM 1130
i. College Admission Records	1		IBM 1401
	1		IBM 407
		1	IBM 1401
		1	IBM 1130
j. Library Circulation Control	1		IBM 357 system & IBM 407
		1	
		1	IBM 1620
4. Other			
a. Student Accounts	1		IBM 1620
b. Enrollment Reports	1		IBM 1620 & 1401

	Presently Handled by E.D.P.	Presently Planned for E.D.P.	Type of System (If located in School)	Name of Outside Agency Providing E.D.P. Services (If equipment is not located in School)
4. Other (Cont'd)				
c. Student Standing & GPA	1		IBM 1130	
d. Mailing Lists	1		IBM 407	
e. Registrars Quarterly Reports	1		IBM 1130	

	Subject - Matter	Presently Handled by E.D.P.	Presently Planned for E.D.P.	Type of System (If located in School)	Outside Agency Providing E.D.P. Services
II. Instructional Applications					
A. Computer-Assisted Instruction in the Classroom.					
(Simulation Information Retrieval)	Physics - Science (et al)	1		IBM 1130	
B. Used as a Computing Aid in Problem Solving					
(Student/ Faculty Research, Class Assigned Problems, etc.)	Chemistry	1		IBM 1620 & 1401	
	Physics	1		IBM 1620 & 1401	
	Math	1		IBM 1620 & 1401	
	Comp. Science	1		IBM 1620 & 1401	
	ECON (et al)	1		IBM 1130	
	Physics	1		IBM 1130	
	Math	1		IBM 1130	
	Biology	1		IBM 1130	
	Chemistry		1	IBM 1130	
	All other academic areas		1	?	

	Subject - Matter	Presently Handled by E.D.P.	Presently Planned for E.D.P.	Type of System (If located in School)	Outside Agency Providing E.D.P. Services
B. (cont'd)					
Faculty Research	Math & Physics	1		IBM 1130	
Student Programming	Math	1		IBM 1130	
III. Data Processing Courses Offered					
A. Programming-Regular Curriculum					
1. Business Data Processing		1		IBM 1620 & 1401	
		1		IBM 1620 & Unit Record	
		1		IBM 1130	
			1	Tab System	
2. Scientific Data Processing		1		IBM 1620 & 1401	
		1		IBM 1620	
		1		IBM 1130	
			1	IBM 1130 (Statistics)	

	Presently Handled by E.D.P.	Presently Planned for E.D.P.	Type of System (If located in School)	Name of Outside Agency Providing E.D.P. Services (If equipment is not located in School)
B. Programming-Short Course (Fortran etc)				
1. Business Data Process.	1		IBM 1620 & 1401	
	1		IBM 1130	
2. Scientific Data Proc.	2		IBM 1620	
	1		IBM 1401	
	1		IBM 1620 & 1401	
	1		IBM 1130	
C. Computer Science	1		IBM 1130	
		2	IBM 1620	
D. Numerical Analysis	3		IBM 1620	
	1		IBM 1620 & 1401	
	1		IBM 1130	
E. Operations Research/Syst. Analysis	1		IBM 1130	
		1	IBM 1620	
F. Other				
High School Institute		1	Teletype to CDC 3300 Computer Time Sharing, Inc.	

VI. Private Colleges

Augsburg College
Bethel College and Seminary
Carleton College
College of St. Benedict
College of St. Catherine
College of St. Scholastica
College of St. Teresa
College of St. Thomas
Concordia College
Dr. Martin Luther College
Gustavus Adolphys College
Hamline University
Macalester College
Minneapolis School of Art
North Central Bible College
St. John's University
St. Mary's College
St. Olaf College
St. Paul Seminary

Table 6 summarizes the responses of the Private Colleges

TABLE 6

QUESTIONNAIRE SUMMARY FOR PRIVATE COLLEGES

I. Administrative Applications	Presently Handled by E.D.P.	Presently Planned for E.D.P.	Type of System (If located in School)	Name of Outside Agency Providing E.D.P. Services (If equipment is not located in School)
A. General Business Office Accounting				
1. General Ledger	1		Unit Record	
	1		IBM 1620 & 1401	
	1		IBM 1620 & 1130	
	1		IBM 1401 & Unit Record	
		1	IBM 1620	
		1	IBM 360/30-65K	
		1		Control Data
		1	Unit Record	
		1	IBM 1130	
a. Budgeting	2		Unit Record	
	2		IBM 1401	
	1		IBM 1620 & 1401	
	1		IBM 1130	
		1	IBM 1620	
		1	IBM 360/30-65K	
b. Payroll	1		IBM 1401	
	1		Control Data 1604	
	1		IBM 1620	
	1		IBM 1620 & 1130	
	1			First Nat'l Bank - Mpls.
	2		Unit Record	
		1	IBM 360/30-65K	
		1	IBM 1130	

	Presently Handled by E.D.P.	Presently Planned for E.D.P.	Type of System (If located in School)	Name of Outside Agency Providing E.D.P. Services (If equipment is not located in school)
c. Purchasing	2		IBM 1401 & 1620	
	1		Unit Record	
		1	IBM 360/30-65K	
d. Supplies & Inventory	1		IBM 1620 & 1130	
	1		IBM 1401	
		1	Control Data 1604	
		1	IBM 360/30-65K	
e. Accounts Payable & Receivable	6		Unit Record	
	2		IBM 1401 & 1620	
	1		IBM 1620 & 1130	
	1		IBM 1130	
		1	Control Data 1604	
		1	IBM 360/30-65K	
f. School Insurance	1		Unit Record	
	1		IBM 1401	
g. General Mailing Lists	4		Unit Record	
	1		IBM 1401	
	1		Control Data 1604	
	1		IBM 1620 & 1130	
	1		IBM 1130	
		1	IBM 1130	

	Presently Handled by E.D.P.	Presently Planned for E.D.P.	Type of System (If located in School)	Name of Outside Agency Providing E.D.P. Services (If equipment is not located in School)
h. Gift Record Accounting	2		Unit Record	
	2		IBM 1620 & 1130	
	1		IBM 1401	
	1		Control Data 1604	
		1	Unit Record	
		1	IBM 1130	
i. Alumni File	2		IBM 1401	
	2		Unit Record	
	1		IBM 1620 & 1130	
		3		
		1	IBM 1620	
		1	IBM 1130	
j. Dormatory Records	2		Unit Record	
	1		IBM 1401	
	1		Control Data 1604	
	1		IBM 1620 & 1130	
	1		IBM 1130	
		1	IBM 1130	
k. Financial Aid	3		Unit Record	
	2		IBM 1610 & 1130	
	1		IBM 1401	
	1		Control Data 1604	
	1		IBM 1130	
	1			American Natl'l Bank-Chicago
		1	IBM 360/30-65K	
		1	IBM 1620	St. John's University
		1	IBM 1130	

	Presently Handled by E.D.P.	Presently Planned for E.D.P.	Type of System (If located in School)	Name of Outside Agency Providing E.D.P. Services (If equipment is not located in School)
1. Bookstore	1		IBM 1620 & 1130	
	1		IBM 1620	
		1	IBM 1620	St. John's University
2. Personnel Accounting (Pension, Retirement, Job Evaluation, etc.)	2		IBM 1401	
	1		Unit Record	
		1	IBM 360/30-65K	
3. Student Records				
a. School Directory	2		IBM 1401	
	2		Unit Record	
	1		Control Data 1604	
	1		IBM 1620 & 1130	
	1		IBM 1620	
	1			St. John's University
		1	IBM 360/30-65K	
		2	IBM 1130	
b. Student Census Data	2		IBM 1401	
	4		Unit Record	
	1		IBM 360/30-65K	
	1		Control Data 1604	
	1		IBM 1620 & 1130	
		2	IBM 1130	

	Presently Handled by E.D.P.	Presently Planned for E.D.P.	Type of System (If located in School)	Name of Outside Agency Providing E.D.P. Services (If equipment is not located in School)
c. Transcripts	1		IBM 1401	
	1		IBM 360/30-65K	
	1		Control Data 1604	
	1		IBM 1620 & 1130	
	1		Unit Record	
		1		St. John's University
		1	IBM 1130	
d. Class Lists	5		Unit Record	
	1		IBM 360/30-65K	
	1		Control Data 1604	
	1		IBM 360/30	Mankato Computer Services
	1		IBM 1620 & 1130	
	1		IBM 1401	
	1		IBM 1620	
	1			St. John's University
		1	IBM 1130	
e. Class Scheduling	1		IBM 360/30	Mankato Computer Services
	1			St. John's University
f. Class Sectioning	1		IBM 360/30	Mankato Computer Services
	1			St. John's University
g. Grade Reporting or Analysis	5		Unit Record	
	2		IBM 1620	
	2		IBM 1401	
	1		IBM 360/30-65K	
	1		Control Data 1604	
	1		IBM 360/30	Mankato Computer Services
	1		IBM 1620 & 1130	
	1			Fairway Foods, Inc.
		1	IBM 1130	

	Presently Handled by E.D.P.	Presently Planned for E.D.P.	Type of System (If located in School)	Name of Outside Agency Providing E.D.P. Services (If equipment is not located in school)
h. Test Scoring & Analysis	1		Control Data 1604	
	1		IBM 1130	
	1		IBM 1620 & 1130	
		1	IBM 1620	
		1	IBM 1130	
i. College Admission Records	2		IBM 1401	
	1		IBM 360/30-65K	
	1		IBM 1620 & 1130	
	1		Unit Record	
		1	Control Data 1604	
		1	Unit Record	
		1	IBM 1620	
		1	IBM 1130	
j. Library Circulation Control		1	IBM 1401	
		1	IBM 1620	
		1	IBM 360/30-65K	
4. Other				
Library Periodicals	1		IBM 1401	
Invoicing, Bibliography(s), Radio Station Log	k		IBM 1620 & 1130	

II. Instructional Applications	Subject - Matter	Presently Handled by E.D.P.	Presently Planned for E.D.P.	Type of System (If located in School	Name of Outside Agency Providing E.D.P. Services (If equipment is not located in School
A. Computer-	Soc. Psych	1		IBM 1620	
Assisted		1		Call-A-Computer	Pillsbury
Instruct.	Programming	1		IBM 1620 & 1130	
in the	Business	1		IBM 1130	
Class-	Soc.Psych.,		1	WANG 370, H-P9100	
room	Math-Chem			IBM 1620	
	Econ,Speech,		1	IBM 1130	
	Pol. Sci.				
	ECON		1	IBM 1130	
	ECON		1	-	
B. Used as a	Math,Chem,	1			
Computing	Physics, Psych,				
Aid in	Soc & others			IBM 1620	
Problem		1		Call-A-Computer	Pillsbury
Solving		1		IBM 1130	
	Speech, Soc	1			
	Res.,Institu-				
	tional Res.			IBM 1620 & 1130	
	Physics, Bus.	1		IBM 1130	
	Nat/Beh. Sci.	1		IBM 1130	
	Math, Chem.,	1			
	Soc, Physics			IBM 1620	
	Sociology	1		IBM 1620	
	Math, Physics		1	IBM 1620, WANG 370,	
	Psych, Soc.			H-P 9100A	
	Math, Natural		1		
	Science, Soc.				
	Sciences			IBM 360/30-65K	
	General		1	IBM-Quiktran	IBM (7044)-Chicago Time Sharing Services
	Phys. Sci.		1		
	Soc Sci,				
	Music, Math			IBM 1130	

III. Data Processing Courses Offered	Presently Handled by E.D.P.	Presently Planned for E.D.P.	Type of System (If located in School)	Name of Outside Agency Providing E.D.P. Services (If equipment is not located in School)
A. Programming-Regular Curriculum	1		IBM 1130	
1. Business Data Processing		1	Unit Record	
2. Scientific Data Proc.	1		IBM Quiktran	Chicago-Time Sharing Serv
	1		Call-A-Computer	Pillsbury
		1	IBM 1130	
B. Programming-Short Course (Fortran etc.)	1		IBM 1130	
1. Business Data Process.	1			Pillsbury
		1	IBM 1130	
		1	IBM 360/30-65K	
2. Scientific Data Process.	2		IBM 1620	
	2		IBM 1130	
	1			Pillsbury
		1	IBM-Quiktran	IBM-Chicago Time Sharing Service
		1	IBM 360/30-65K	
C. Computer Science	1		IBM 1620 & 1130	
		1	IBM 1620 & others	
D. Numerical Analysis	1		IBM 1620	
	1		TR-10, IBM 1620	
		2	IBM 1130	
		1	IBM-Quiktran	IBM-Chicago Time Sharing Service
		1		Pillsbury
		1	IBM 360/30-65K	

VII. University of Minneosta

A comprehensive report entitled Computing at the University, 1968 prepared by Dr. Frank Verbrugge presents a summary of the computing available facilities at the University of Minnesota.

The following is taken from Dr. Verbrugge's Report.

A. General Purpose Facilities

1. The UNIVERSITY COMPUTER CENTER (UCC). The equipment of UCC includes a CDC 6600, a CDC 1604, and a CDC 160. Its equipment and personnel are located in Experimental Engineering, the Computer Center on Highway 280 (NSP Building), and later in 1968 in the Space Science Building. Its director is Marvin Stein. The CDC 6600 system is an expandable integrated network of computer stations. Three of these stations are in operation or are being developed: the Space Science Station, the West Bank Computer Center (WBCC), and the Bio-Medical Data Processing Center (BDPC). The latter two centers also serve local functions and, therefore, are identified separately. Several other satellite stations for the 6600 system have been recommended by the Advisory Committee and will be developed as funds become available.

2. The BIO-MEDICAL DATA PROCESSING CENTER (BDPC) is currently housed in Masonic Hospital. The staff occupies space in Powell Hall. The staff will be moved to space in the VFW Building when that space has been prepared. Its director is Eugene A. Johnson. The facilities and the programs of BDPC have to date been entirely funded by direct support grants from NIH. Effective July 1, 1968, there will be a gradual change-over in the pattern of funding. The operating support will be funded through individual research grants and contracts rather than by a direct grant to the Center. It is anticipated that this transition will have been completed by July 1, 1969. The computer is a CDC 3300 with a connecting link to the 6600.

3. The ST. PAUL COMPUTER CENTER (StPCC). The staff and facilities of StPCC are located in a number of areas in North Hall. Its director is Hugo H. John. Approximately 65% of the activities of StPCC are of a specialized nature: to maintain production records for approximately 200,000 dairy cows -- a project supported by the Dairy Herd Improvement Association, and most of the remaining support comes from individual projects in the Agriculture Experiment Station. The computer is an IBM 360/30.

4. WEST BANK COMPUTER CENTER (WBCC). The budget for this center, as described in this report, encompasses the activities of the Management Information Systems Research Center (MISRC), the Social Science Research Facilities Center (SSRFC), and other academic units or centers in the School of Business Administration and the College of Liberal Arts. Gordon B. Davis is director of MISRC and has to a large extent assumed responsibility for the development of the computing facilities on the West Bank which is currently taking place. The WBCC occupies space in the basement of Blegen Hall. Its computer will be a CDC 3200 which will serve both as a local interactive system and as a satellite of the CDC 6600. In addition to its use of the 3200 system, SSRFC has an IBM 1620.

5. The DATA PROCESSING CENTER (DPC). This center is located in the basement area of Morrill Hall and a connecting link to the Physics Building. Its director is Ralph J. Willard. Its system has been an IBM 1410, now being replaced by an IBM 360/50. The 1410 was used largely for business administration purposes. The capability of the 360/50 will allow for expansion of programs in other areas (for example, such as student admissions, class schedules, registration and the like) iether on site or through the establishment of remote terminals. Most of the support of the Center comes from regular budgetary funding.

6. UNIVERSITY OF MINNESOTA, DULUTH COMPUTER CENTER (UMD). This center is located in Science Hall. Its current system is an IBM 1620; an IBM 360/44 has been leased and will be installed in August, 1968. The acting director for the Center is John L. Gergen.

7. CENTER FOR HUMAN LEARNING (CHL). This center is located on the fourth floor of Ford Hall. Its director is Russell W. Burris. The center has received support from the Hill Family Foundation, from the National Science Foundation, and from the University. The main focus of the Center's activity is computer-assisted learning and in particular, an in-depth analysis of human learning behavior as made evident in human interaction with a computer and its peripheral equipment. The system is an IBM 1500.

B. Specialized Facilities

A large variety of specialized computing facilities exists at the University. Only those are listed which use electronic digital computing equipment as a major or as an essention component.

1. Hybrid Computing Facility. The operations of the hybrid facility are funded by outside grants and some University support. This facility was established by a grant of $400,000 in 1966 from the National Science Foundation. It consists of two EAI 680 analog computers and a CDC 1700 digital computer. Its manager is John K. Munson and operationally it is part of UCC. It is located in the Computer Center on Highway 280 and will be moved later in 1968 to the Space Science Building.

2. Tandem Accelerator Computing Facilities. A CDC 3100 supported by a grant from AEC at a cost of approximately $225,000 is located in John H. Williams Laboratory of Nuclear Physics. Russell K. Hobbie is largely responsible for its management. The functions of the computer include data acquisition from the Tandem Accelerator, preliminary analysis of the data generated, and some machine control for the accelerator. The activities of the laboratory and its computer are funded by AEC.

3. The Department of Pathology has Data Machine Incorporated, Varian Associates, and Calcomp computing equipment purchased in 1966-67 at a cost of approximately $450,000. The system is associated with the research program of Frantz Halberg.

4. The Department of Physical Medicine and Rehabilitation purchased LINC and PDP8 computing equipment in 1966-67 at a cost of approximately $50,000. William G. Kubicek supervises this program.

5. The Department of Radiation Therapy will purchase LINC equipment during 1968-69 at a cost of approximately $28,000. Merle K. Loken will be in charge of this facility.

6. The Department of Physiology leases an IBM 1800 system at a cost of approximately $28,000 per year. The facility is under the supervision of Carlo Terzuolo.

7. The Department of Psychology has a CDC 160 in support of David LaBerge's work in human response and memory. It is anticipated that this system will be replaced by a PDP8 sometime during 1968-69.

8. The Bio-physics Laboratory under Otto H. Schmitt as director has a PDP5 purchased in 1965 at a cost of $27,000 and a PDP8 purchased in 1966 at a cost of $18,000. This laboratory as of July 1, 1968, is in the Department of Electrical Engineering; previously it was jointly in the School of Physics and in the Department of Zoology.

9. Audio-Visual Extension leases IBM computing equipment and peripheral equipment at a cost of approximately $19,000 per year to maintain inventory, circulation and accounting control for the distribution of its films. This film distribution currently is at a level in excess of 300,000 films per year and involves some 1,500 customers each month. W. D. Philipson is director of the department.

C. Time-Sharing Systems

During 1967-68, the University of Minnesota experienced a major expansion in the use of time-sharing terminals. Time-sharing here is identified as an on-line remote terminal which shares in a time sequence the full capabilities of a computing system remotely located. That is, at first approximation, the customer has the impression of having the full system available to him. It is somewhat different in its operation, therefore, from an on-line remote batch processing terminal. During 1967-68, 11 terminals were located on the Twin Cities campus. The operating cost for the terminals was approximately $48,000 and to a large extent was funded by regular departmental or college funds. Two computer systems were involved: Call-A-Computer and Comshare. Call-A-Computer uses its Minneapolis facilities and Comshare is located in Chicago. Contracts were signed on a departmental basis. For 1968-69, additional systems providing time-sharing services include Computer Time Sharing and perhaps the IBM Data Processing Center in Chicago (one of 12 data processing centers being established in the United States, each using a 360/50 computer for time-sharing and a 360/40 for batch processing. Call-A-Computer uses GE computers, Comshare uses an SDC, and Computer Time Sharing uses a CDC 3300. For 1968-69, a single University contract will be made available by most of the firms. This provides the advantage of reduced rates which result from the decreasing hourly cost rate as the usage increases. For 1968-69, the program will again be funded by individual departments and colleges. The policy for the program is under the direction of a sub-committee of the Advisory Committee with Peter J. Roll as chairman of the sub-committee. William D. Munro of UCC is in charge of the time-sharing operations.

QUESTIONNAIRE FOR INSTITUTIONS OF HIGHER EDUCATION

I. Administrative Application A. General Business Office Accounting	Presently Handled by E.D.P.	Presently Planned for E.D.P.	Type of System (If located in School)	Name of Outside Agency Providing E.D.P. Services (If equipment is not located in School)
1. General Ledger	______	______	______	______
a. Budgeting	______	______	______	______
b. Payroll	______	______	______	______
c. Purchasing	______	______	______	______
d. Supplies & Inventory	______	______	______	______
e. Accounts Payable or Receivable	______	______	______	______
f. School Insurance	______	______	______	______
g. General Mailing Lists	______	______	______	______
h. Gift Record Acctg.	______	______	______	______
i. Alumni File	______	______	______	______
j. Dormatory Records	______	______	______	______
k. Financial Aid	______	______	______	______
1. Bookstore	______	______	______	______

2. Personnel Accounting (Pension, Retirement, Job Evaluation, etc).

3. Student Records

   a. School Direcotry

   b. Student Census Data

   c. Transcripts

   d. Class Lists

   e. Class Scheduling

   f. Class Sectioning

   g. Grade Reporting or Analysis

   h. Test Scoring or Analysis

   i. College Admission Records

   j. Library Circulation Control

II. Instructional Applications

	Subject - Matter	Presently Handled by E.D.P.	Presently Planned for E.D.P.	Type of System (If located in School)	Name of Outside Agency Providing E.D.P. Services (If equipment is not located in school)
A. Computer-Assisted Instruction in the Classroom					
(Simulation, Tutorial, Drill,& Practice, Information Retrieval, Computer Based Teaching Machine, Stimulus Sequencing etc.)	______	______	______	______	______
	______	______	______	______	______
	______	______	______	______	______
	______	______	______	______	______
B. Used as a Computing Aid in Problem Solving					
(Student/Faculty Research, Class Assigned Problems, etc.)	______	______	______	______	______
	______	______	______	______	______
	______	______	______	______	______

III. Data Processing Courses Offered

	Presently Handled by E.D.P.	Presently Planned for E.D.P.	Type of System (If located in School)	Name of Outside Agency Providing E.D.P. Services (If equipment is not located in School)
A. Programming-Regular Curriculum	______	______	______	______

1. Business Data Processing ____ ____ ____ ________

2. Scientific Data Process. ____ ____ ____ ________

B. Programming-Short Course (Fortran etc) ____ ____ ____ ________

1. Business Data Process. ____ ____ ____ ________

2. Scientific Data Process. ____ ____ ____ ________

C. Computer Science ____ ____ ____ ________

D. Numerical Analysis ____ ____ ____ ________

E. Operations Research/Syst. Analysis ____ ____ ____ ________

F. ____ ____ ____ ________

G. ____ ____ ____ ________

H. ____ ____ ____ ________

QUESTIONNAIRE FOR ELEMENTARY AND SECONDARY SCHOOLS

Please indicate the Areas in Which Electronic Data Processing (EDP) Equipment is Utilized in Your School Program.

A. Administrative Applications 1. General Business Office Accounting.	Presently Handled by E.D.P.	Presently Planned for E.D.P.	Type of System (If located in School System)	Name of Outside Agency Providing E.D.P. Services (If equipment is not located in School System)
General Ledger				
Budgeting				
Payroll				

Purchasing				
Extraclassroom Activity Accounting				
Transportation Requirements				
Supplies & Inventory				
Accounts payable & Receivable				
School Insurance				

Maintenance

Lunch Program

Expense Analysis &
Monthly Receipts

Annual Financial Statement

Census

W2

Tax Reports

2. <u>Personnel Accounting</u>

(Pension, Retirement, Job
Evaluation, etc.)

3, <u>Student Records</u>

School Directory

Student Census Data

Transcripts

Class Lists

3. Training in E.D.P.	Subject-Matter	Presently Handled by E.D.P.	Presently Planned for E.D.P.	Type of System (If located in School System	Name of Outside Agency Providing E.D.P. Services (If equipment is not located in School System)
Programming (Separate Course)					
Programming (Unit in Existing Course)					
Keypunching					
Wiring Unit Record Equip.					

Tabulating
Equipment
Operator

Modular
Scheduling

Accumulative
Record
Labels

B. Instructional Applications

1. Computer-Assisted Instruction in the Classroom

1. (con'd)

(Simulation, Tutorial, Drill & Practice, Information Retreival, Computer Based Teaching Machine, Stimulus Sequencing, etc.)

2. Used as a Computing Aid in Problem Solving

(Student/Facultv Research, Class Assigned Problems, etc.)

Library Circulation Control

Attendance

Misconduct Reports and Analysis

Athletic Tickets & Acctg

Identification Cards

Health & Dental Records

Honor Roll

Locker
Assignments

Class
Sectioning

Grade
Reporting
or Analysis

Test Scoring
or Analysis

College
Admission
Records

APPENDIX C

The State Plan

(Characteristics of a Network Model for Regional Information Systems for Minnesota Elementary and Secondary School Districts)

CHARACTERISTICS OF A NETWORK
MODEL FOR REGIONAL INFORMATION SYSTEMS
FOR MINNESOTA ELEMENTARY AND SECONDARY
SCHOOL DISTRICT

A Report to the
Minnesota National Laboratory,
State Department of Education

by

Gary A. Mohrenweiser

and

Van D. Mueller

Preface

This report on characteristics of a network model for regional educational information systems for Minnesota elementary and secondary school districts was prepared under the auspices of the Minnesota National Laboratory, State Department of Education.

The increase in the quality and quantity of computer services available to the elementary and secondary school districts in Minnesota, the rapid growth of interest in multi-district cooperative service agencies, and the increasing complexity of the information requirements necessary to manage the administrative and instructional programs demand a planned, coordinated and systematic developmental process. The creation of a statewide network of educational information systems will require coordination of the efforts of educational organizations: state, local and regional, and the creation of compatible systems oriented to the concept of integrated information systems rather than the traditional application-oriented data processing.

The purpose of this report is to (1) discuss preliminary characteristics of a statewide network system to meet projected needs for educational information, and (2) make preliminary recommendations for implementation of the network design. Part I of the report presents the major recommendations in summary form. The following sections, Parts II-V provide the definition, rationale, and detailed information necessary to the understanding of each recommendation.

Acknowledgements

The authors wish to acknowledge the cooperation and assistance of the many persons who contributed to the preparation of this report. Primary recognition is given to the following members of the Planning Committee for Coordination of Information Systems:

Dr. Gayle Anderson, Consultant, Planning and Development, State Department of Education

Mr. Thomas Campbell, Direcotr of Educational Services, Minnesota School Districts Data Processing Joint Board (TIES)

Mr. David Dye, Consultant in Mathematics, State Department of Education

Mr. Al Hauer, ARIES Corporation

Mr. W. W. Keenan, Administrator, Minnesota National Laboratory, State Deparment of Education

Dr. Robert Leestamper, Assistant Executive Director, Minnesota Higher Education Coordinating Commission

Mr. Harlan Sheely, Director of Information Systems, State Department of Education

This report is an outgrowth of discussion with the above persons and others interested in planning and establishing an improved educational information system for the elementary and secondary school districts of Minnesota.

GAM
VDM

TABLE OF CONTENTS

PART I SUMMARY OF MAJOR RECOMMENDATIONS

INTRODUCTION

This section of the report presents in summary form those recommendations which are seen as an integral part of the planning, development, and implementation of a state wide computer network for elementary-secondary education in Minnesota. Within the main text of the report these recommendations, together with others, are discussed in detail. It should be emphasized that these recommendations are preliminary in nature and that extended discussion, study and evaluation should be an integral and continuous facet throughout the development of the network.

IT IS SUGGESTED THAT A COORDINATED APPROACH IS NECESSARY TO INSURE EFFECTIVE UTILIZATION OF COMPUTERS AT THE ELEMENTARY-SECONDARY LEVEL IN THE STATE OF MINNESOTA. THIS FORMS THE BASIS FOR THE FOLLOWING RECOMMENDATIONS:

I. IT IS RECOMMENDED THAT THE REGIONAL CONCEPT OF EDUCATIONAL INFORMATION CENTERS PRESENTS A VIABLE ALTERNATIVE FOR SATISFYING THE EDUCATIONAL INFORMATION NEEDS OF THE STATE.

II. IT IS RECOMMENDED THAT THE REGIONAL INFORMATION CENTERS BE MODULAR IN RELATION TO THE ELEVEN STATE PLANNING REGIONS AND THE PLANNED MULTI-FUNCTIONAL EDUCATIONAL SERVICE AREAS.

III. IT IS RECOMMENDED THAT THERE BE NO MORE THAN SEVEN NOR LESS THAN FOUR REGIONAL EDUCATIONAL INFORMATION CENTERS.

IV. IT IS RECOMMENDED THAT THE COORDINATION, PLANNING AND DEVELOPMENT OF A STATEWIDE NETWORK OF REGIONAL EDUCATIONAL INFORMATION CENTERS IS AN INTEGRAL PART OF THE STATE SYSTEM OF ELEMENTARY AND SECONDARY EDUCATION AND THEREFORE BELONGS UNDER THE IMMEDIATE JURISDICTION OF THE STATE BOARD OF EDUCATION.

V. IT IS RECOMMENDED THAT A STEERING COMMITTEE BE CREATED TO ASSIST THE STATE DEPARTMENT OF EDUCATION IN POLICY, PLANNING, DEVELOPMENT, IMPLEMENTATION AND EVALUATION OF THE SYSTEM AND THAT A STAFF POSITION BE CREATED WITHIN THE STATE DEPARTMENT OF EDUCATION AT THE LEVEL OF ASSISTANT COMMISSIONER TO PROVIDE LEADERSHIP AND ADMINISTRATIVE SUPPORT FOR THE DEVELOPMENT AND OPERATION OF THE NETWORK SYSTEM.

VI. IT IS RECOMMENDED THAT THE STATE BOARD OF EDUCATION UNDER THE ARM OF A STEERING COMMITTEE ENLIST THE ASSISTANCE OF AN INDEPENDENT CONSULTANT FIRM TO DEVELOP IN DETAIL A PLAN WHICH WOULD BE ENDORSED BY THE BOARD AND PRESENTED TO THE NEXT LEGISLATIVE SESSION FOR APPROVAL.

VII. IT IS RECOMMENDED THAT THE TIES MODEL BE ADOPTED AND UTILIZED FOR THE DEVELOPMENT OF THE REGIONAL CENTERS.

IX. IT IS RECOMMENDED THAT THE FULL COST OF DEVELOPMENTAL ACTIVITIES BE ASSUMED BY THE STATE.

X. IT IS RECOMMENDED THAT ALL LOCAL EDUCATIONAL AGENCIES, INTERMEDIATE AND/OR REGIONAL SERVICE UNITS OR DISTRICTS BE PART OF THE REGIONAL EDUCATION INFORMATION SYSTEM.

XI. IT IS RECOMMENDED THAT THE NETWORK OF REGIONAL EDUCATIONAL INFORMATION CENTERS BE COORDINATED WITH THE DEVELOPMENT OF REGIONAL EDUCATIONAL SERVICE AGENCIES.

XII. IT IS RECOMMENDED THE OVERALL PLAN FOR A STATE WIDE NETWORK SYSTEM PLACE MAJOR EMPHASIS UPON COMPATIBILITY OF DATA BASES, HARDWARE, SOFTWARE, AND INFORMATIONAL REPORTING.

XIII. IT IS RECOMMENDED THAT A REALISTIC TIME SCHEDULE, SUCH AS THE ONE OUTLINES IN TABLE 4 OF THIS REPORT, BE ADOPTED FOR IMPLEMENTATION OF THE STATE WIDE NETWORK.

PART II INTRODUCTION TO INFORMATION SYSTEMS

INTRODUCTION

In a document entitled Recommendations for Coordinated Computer Development in Minnesota Post-Secondary Education. The Minnesota Higher Education Coordinating Commission presents the following four points as reasons that the State of Minnesota maintain a coordinated approach to the utilization of computer resources:

A. The State can experience an economy by precluding the need for a complete computer installation at every institution.

B. Effective use of expensive computer resources can result when the equipment is completely used for longer periods of time as additional institutions have access to the machines.

C. An improved quality of service and educational opportunities can be experienced when smaller institutions have access to a computer installation with greater capability than they would ordinarily be able to afford at their location.

D. This will permit Minnesota institutions to be incorporated into a national computer network as one develops.

These points are relevant not only to post secondary education but also, and possibly to a greater degree, to elementary-secondary education. Computer facilities are expensive to install, operate and maintain. In addition to complex hardware needs, a greater expense is experienced in personnel for software development and operations. Resources available for development of any undertaking are limited and computer development for elementary-secondary education is no exception.

Like the purpose of the report from the Minnesota Higher Education Coordinating Commission, this paper directs attention toward an integrated statewide system for education in Minnesota. Integration at the administrative level is concerned with planning the administrative organization such that those agencies and individuals who at some time in the operational phase are affected, will be represented in the planning and development phases. Thus, not only elementary-secondary schools must share in the planning but also agencies such as the State Department of Education, area vocation-technical schools, intermediate units and other public and non-public agencies across the state.

It is not the purpose of this paper to explore possible hardware considerations. It is rather, to present and discuss those considerations which must first be undertaken to establish an administrative structure which can and will foster economical and effective hardware and software development. This paper will attempt to discuss in general terms some administrative considerations which would tend to conserve and effectively combine those resources in the most desirable mix. All too often information systems are built around hardware considerations only. To such systems has often been applied the term "management misinformation systems." The design of such systems which are dependent upon hardware cannot be fully responsive to the user, whether the user be an individual, private or public institution or whatever. The design of the system is dependent upon those objectives as determined by the administrative framework of the user.

ELEMENTS OF AN INFORMATION SYSTEM

An information system has been defined by some as a collection of people, procedures, computer hardware and software, and a data base organized to develop the information required to support the given organization or function for which it was designed. An information system can then be dissected into a 1) data base and 2) a data processing system.

A data base may be thought of as a set of discrete, irreducible data elements. No data element can be subdivided further. Data elements, however, can be combined to produce derived data or information. For example, the student's name or birthdate is a data element whereas the measure of average daily attendance is produced from a combination of particular data elements. The data base of regional or a state wide information system has the same characteristics.

If one considers a state wide system as a collection of regional systems the data base becomes of prime importance. Each regional center has certain informational requirements which dictate which data base elements will be maintained in that system. Likewise the state agency (in this case the State Department of Education) requires certain informational reporting which again dictates a particular set of data elements. In addition there may be certain regional informational exchanges which again will formulate a particular set of data elements. Also other agencies may require information directly from individual members of the regional organization or state wide system. Each of these informational needs may have both unique and common aspects.

In design of an information system it becomes important that all informational needs are reduced to their basic data elements. From these irreducible data elements the particular data base of each regional center can be determined. Suppose there are three regional centers as represented by the three circles in Figure 1. Each region

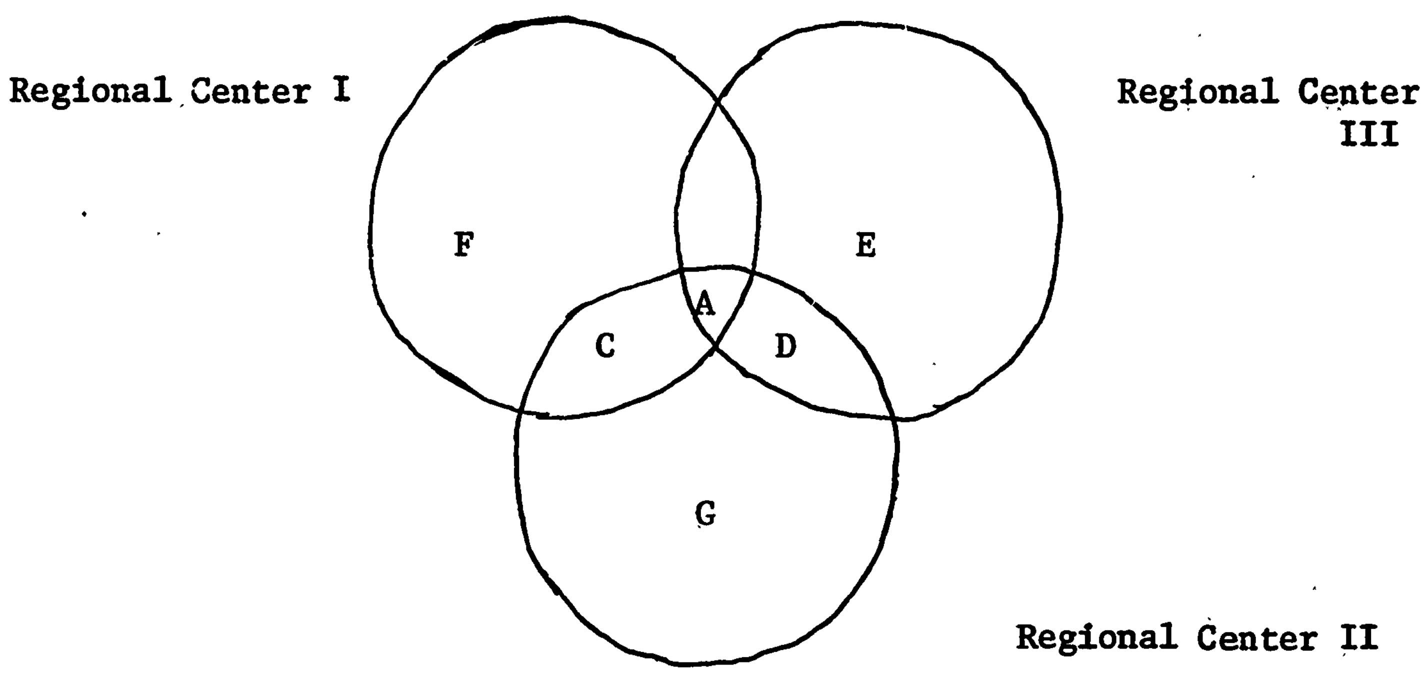


Figure I

has its unique informational needs as represented by the areas E, F, and G. Area C represents informational demands common to Region I and Region II but not Region III. Likewise Area D represents the common informational demands characteristic only to Regions II and III. Regions I and III share information represented by Area B. Area A represents the informational needs common to all regions. This is the area in which there is complete and total compatibility of data elements. Each of the other areas have varying amounts of compatibility. Only from Area A could be derived information which would permit the comparison of the three regional centers. If other data bases were used in this comparison the information might not be comparable. Unless the regional centers have compatible data bases it is impossible to derive compatible information.

A second stage in information compatibility is that of derived information and may result from some type of mathematical manipulations and it would require that these formulas be defined consistent throughout the regional centers. An example might be school systems that compute grade point averages using different conversion numbers. Each school system could collect grades in the form of A,B, C,D, and F's but if one were to use a 4.0 scale and the other a 5.0 scale, compatibility of information would not exist. This represents a situation in which there is compatible data bases but through the translation, this compatibility was lost.

From what is generally termed an education information system at least three important functions may be derived:

A. Information for decision making

B. Data processing

C. Computer assisted instruction

The data processing system consists of the computer hardware, computer software, and procedures necessary to collect, transform, and distribute data elements to those who will use them. It is not true that a data processing system represents an information system.

Data and information are not identical. Data provides a basis for information. Much data is collected on pupils, teachers, programs, facilities, and finance but only when this data is put to use in the decision process does it become information. Many of the functions which find applicability to electronic computers in elementary-secondary schools are data processing functions. For example, the process of writing payroll checks, recording deductions, etc. is a data processing function as is the process of preparing mailing labels for enrolled students. However, retrieval of summary information on the two above processes could provide information for decision making and hence be an informational function of the system. For example, analysis of overtime payrolls for non-certified employees may provide a basis of information for decision making relative to overtime policies. Such a procedure draws from a data base, the distinguishing characteristics of an information system.

Instructional aspects as they relate to the computer in an educational organization are probably the most educationally desirable utilization of the advanced technology. In most organizations however the data processing and information function proceed the instructional pahse. Reasons for this include the fact that education in its application of the computer has largely followed the prior application in industry and business. Immediate and identifiable payoffs can be derived from payroll and inventory applications. These payoffs can be more clearly identified than instructional functions.

Each and every school district has certain data processing and informational functions in common with all other districts. In addition it has some unique requirements. The "uniqueness" of the process may be more a function of time rather than a need. The district which is considering a bond issue may desire a sampling and analysis procedure to access the upcoming vote. This need may arise but once every five years. For an individual district to develop elaborate hardware and software capabilities for "one shot" needs is economically unfeasible. A solution however might be found in a cooperative venture by several districts. Many activities which began as a unique application in one district find application at some later date in other districts.

The computer today finds its primary application in areas which involve the processing of large volumes of data in a routine and repetitive manner. The investment of hardware and especially software for unique or seldom utilized operations is prohibitive. Such functions are better handled on a manual basis. Likewise the small repetitive function, such as payroll for ten employees is not a feasible computer function.

Some educational organizations separate the on-going functions into:

A. Finance

B. Facilities

C. Pupils

D. Personnel

E. Programs

These functions are common to all school districts. In the development of hardware and software configuration to support such systems it is characteristic that the expenditures for most districts are constant and independent of size. Since each district operates under much the same format in development and operation of such procedures it argues for a cooperative venture by local school district.

It remains a fact that there is no one school district in Minnesota, including Minneapolis, which is capable of efficient and effective support of computer facilities. It appears that the only alternative to effective and economical computer utilization is thru regional centers. Regional centers can retain responsiveness to local and regional needs while at the same time provide an adequate pupil base to support hardware and software development necessary to meet the needs of educational institutions.

THE FUNCTION OF AN INFORMATION SYSTEM

Electronic computers produce a product and that product has a cost associated with it. That product may be information for decision making, it may be instruction or a wide range of products. Each product must be examined in two respects. First, the value of the product itself. The question becomes, does this product justify the expenditure and other resources necessary for its production. Second, what is the relationship of this product to the other possible products produced by the system. Such considerations establish priorities of the various products:

1. What products are needed? In questioning any number of individuals within an educational organization as to what computer products are needed one would probably obtain about as many different responses as individuals questioned. The business manager would probably indicate payroll. The math instructor would suggest a terminal for mathematical calculations in his classroom etc. It is further true that few if any of these individuals could tell you really what products are needed. Need and desirability are not the same. Need implies economical feasibility and usefulness of the product. The concept "it would be nice to have" does not present a valid argument to the committment of resources to production of the product.

2. Who will use these products and what function does the user see in these products? A product can be economically feasible to produce; however, if it finds no user, it then supplies no value to the system. The product which is useful in system A may not find application in system B. The failure of the product to find application in system B may not be a result of the inherent differences of the system but one of attitudes of the personnel who are making the application.

   The purpose of the derived product is of primary importance. The resulting effect upon the total organization and benefit to the organization is the determining factor in assessing the value of the specific computer application. Not all computer application would prove profitable to an organization. Many applications can be better developed and maintained by a manual system.

   As an example of one important phase and function of a computer application, consider the control function of an information system. The general criteria calls for a system that is characterized by comprehensiveness, balance, efficiency, effectiveness and creativity.

A. Comprehensiveness - Every decision maker is concerned about overlooking or omitting some important piece of feedback information. The management Information System should cover all aspects of the operation that should be controlled. However, the degree of comprehensiveness will be different at the various levels of management. At lower levels of management the detail of the M.I.S. will be much greater than at higher levels. The information needed by a principal concerning a given student is different from that needed by the classroom teacher. The principal would probably be in need of summary characteristics on the student whereas the classroom teacher would use specific test scores, I.Q. results, etc. If one considers the budgetary system the information needed by the board of education for control purposes is markedly different than that required by the departmental chairman. Comprehensiveness is examining the requirements of the total system.

B. Balance - In the design of the M.I.S. it is important that those individuals responsible for design provide balance in the controls system. It is a common tendency of designers to over-emphasize management controls in their own area. It is necessary to have a design team which can view the controls system as a whole and balance all aspects of the system. Each individual on the management team is responsible for certain controls. To ascertain the phase of the organization this individual relies upon information. Too much information can be as harmful as too little information.

C. Responsiveness - The information system must be capable of relaying information to management as soon as possible after occurrence of significant events. The system must be designed to provide such current information as needed. For example, the financial system should provide nearly immediate updating of the financial picture to the organization.

D. Effectiveness - Design the system such that a minimum number of pieces of control information is re-required to make a decision. But on the other hand, the control indicator should not be reduced to the point at which the management loses contact with part of the system because they now rest decisions upon only a few indicators. Systematic evaluation of the system and its products will force management to maintain close contact with those requirements which at one time appeared important and necessary to them.

E. Creativity - Allow the design teams to be creative. Many set patterns are available for the M.IS. These are proven and true techniques. However, the "status quo" is not necessarily the best way to maintain a system. Provide a creative environment, both in atmosphere and support.

What the Information System does for Management.

A. It can Inform - Management must keep pace with the operation. Updating oneself with information is a continual job.

B. It Can Help to Predict Events - The controls system can be examined for trends within the organization. Prediction can be made from trend information and planning can take place.

C. It Can Help in Diagnosing Problems - In many instances, management has reason to believe that a problem exists or is about to appear. By anal sis of the information many problems can be identified and isolated.

D. It Can Reinforce Memory - Critical and important feedback information is needed as a constant reference to update management. A good controls system permits the decision maker to run the operation rather than the operation running him.

The above consideration along with many others as they relate to the other overall objectives of education determines the direction of computer applications. From these processes and developments evolve other stages in the computer application. The most important phase of which may well be the training and involvement of personnel as they relate to the total function. For example, it has been suggested by some that an immediate need is to provide a computer terminal experience for every math student in the state. One does not question the wisdom of the overall objective but the means to reaching this objective. If, overnight, a computer terminal could be made available to every math student the result and productivity of such a venture would prove to be questionable. One of the major variables in this operation would be the ability of the math teacher to effectively utilize the computer terminals. With the variability between not only the schools but also teachers and students, immediate implementation without consideration of the previous factors would provide not only uneconomical but educationally questionable.

The above example has its parallel in the management area. Within a regional organization it would probably be true that the informational requirements of principals would not be the same for all schools. If suddenly common information were made available to all principals much of the effort involved may not prove of benefit. Orientation of the individual to the system must be an integral part of the development.

PART III ROLES AND RELATIONSHIPS OF REGIONAL EDUCATION INFORMATION SYSTEMS TO OTHER EDUCATIONAL AND GOVERNMENTAL AGENCIES

INTRODUCTION

The purpose of this section of the report is to present general guidelines governing the relationships of the proposed regional educational information systems and the many institutions and agencies which can profitably benefit from coordination and cooperation. These include:

1. Constituent local school districts
2. The State Department of Education
3. The University of Minnesota
4. The State College Systems
5. The Junior College System
6. Area Vocational-Technical Schools
7. Regional Educational Service Agencies/Intermediate Unit
8. Other governmental agencies: local, state and regional
9. Non-public Educational Agencies

This study attempts to limit its examination to regional educational information systems of a comprehensive type. Such comprehensive systems include cross-functional and inter-level information about elementary and secondary education as a whole. It should be noted that the establishment of computer-based educational information systems inevitably create an impact on organizational relationships. The creation of more extensive and elaborate information handling systems in education requires a carefully planned appraoch to interagency communication, coordination and cooperation. The information needs for the operation and management of modern educational program are not restricted by arbitrary organizational or political boundaries.

The late 1960's have represented a period of increased recognition of inter-dependence among social and educational agencies. Cooperative planning and program coordination have afforded the opportunity for multi-functional approaches to the solution of common problems. The regional educational information system network can serve as a catalyst to legitimatize inter-organization coordination and cooperation.

RELATIONSHIPS WITH CONSTITUENT LOCAL SCHOOL DISTRICT

Computers tend to be utilized in education in two broad areas - operations and information. These two types of applications are not mutually exclusive by any means. Historically, the location of the hardware complex has been dictated considerably more by specific operational application needs than by informational aspects. The recommended relationships with local school districts presented in this report assume that data processing activities (operations) may be conducted on either a regional or individual district basis dependent upon the operational needs and requirements of the local school district. Thus the autonomy of local school districts would be reserved to the operational aspects of the computer.

Local school districts large enough to justify existing computer installations could thusly continue to provide for their operational needs, develop a dual-system with a regional processing center, or choose to abandon district-level processing efforts in favor of the services of a regional center.

It is recommended, however, that all local educational agencies, intermediate and/or regional service units or districts be part of the regional educational information system. The regional center should have overall responsibility for systems design, data comparability, systems planning and status reporting of information to state and federal agencies. Thus, the regional educational information system network would include all elementary and secondary school districts in the State as constituents of one of its cooperative regional centers.

THE STATE DEPARTMENT OF EDUCATION

It is recommended that the role of the State Department of Education be considered as three-fold: policy-making and control, development and promotion, and coordination. The Department should continue its leadership in the development of a network of regional educational information systems by adopting policies designating boundaries for multi-functional support services as well as educational information systems; by forcasting state information needs and coordinating their collection and processing through regional centers; by encouraging system developments from the standpoint of the local school district rather than from the departmental level; and coordinating research activities, output, and software development at the local and regional levels to assure reliability and efficiency.

THE UNIVERSITY OF MINNESOTA, STATE COLLEGE SYSTEM, JUNIOR COLLEGE SYSTEM

It is recommended that the development and implementation of a network of regional educational information systems for elementary and secondary schools be coordinated with all post secondary institutions. Such liaison and coordination could best be established at the State level through the Minnesota Higher Education Coordinating Commission and the State Department of Education. In order to promote maximum utilization of human and financial resources such coordinated activity should include: consideration of mutual information requirements; training and retraining of necessary educational and technical specialists; provision of resource people to meet regional and local district requirements; and cooperative research and development projects of mutual concern.

At the regional level it is recommended that liaison with post-high school institutions be developed according to local and regional requirements. Potential cooperative activities for some regions could include sharing of computer resources, personnel and facilities with one or more agencies on a periodic or continuous basis. It should be noted that the coordination of information system components is recommended for state-level action, whereas coordination and cooperation in computer processing activities is deemed to be best served through development at the regional level.

AREA-VOCATIONAL TECHNICAL SCHOOLS

It is recommended that all area-vocational-technical schools be included in the information system aspects of the regional centers. In addition it is recommended that communication patterns be developed at both state and regional levels concerning the technical manpower requirements of expanded regional processing centers and information systems. The mutual advantages of joint employment of specialized personnel by area vocational-technical schools and regional educational information system centers should be explored. Special attention should be directed toward the regional personnel requirements necessary to coordinate and conduct in-service training of local district personnel.

REGIONAL EDUCATIONAL SERVICE AGENCIES/INTERMEDIATE UNITS

It is recommended that the establishment of the proposed network of regional educational information systems be coordinated with the development of regional educational service agencies. The planners of multi-purpose regional support agencies consider the possible desireability of a modular approach to delivery of services, such design to enable two or more regional service agencies to combine for purposes of establishing a regional educational information system. This design approach would recognize the differential re-requirements for various support services, i.e. data processing, special education, vocational education, etc.

It should in addition be recognized, that the growth and development of the network of regional educational information systems is directly related to the servicing functions of regional computer processing services to local school districts. The development of regional boundaries for a variety of support services of immediate practical value to local school districts can enhance the development of the proposed network of information systems.

OTHER GOVERNMENTAL AGENCIES: LOCAL, STATE, AND REGIONAL

It is recommended that development and implementation of the network of regional educational information systems be consistent in design with the already established planning and economic regions within the state. Special consideration should be given to cooperating in the establishment of regional data banks which include demographic, economic, physical and other types of planning data. Compatibility of educational data with data from other social, health, and welfare agencies should be a priority objective. The interface with integrated regional information systems should be considered in the planning of the educational information component. This possibility is unlikely to be fruitful unless quick and effective means of communication between special purpose regional and information systems are established from the outset.

NON-PUBLIC EDUCATIONAL AGENCIES

The creation of a network of regional educational information systems for the elementary and secondary school districts of Minnesota should include, at a minimum, procedures to integrate complete information on the pupil and professional personnel of the non-public schools of the state. It is recommended therefore, that the State Board of Education exercise the necessary authority to require the collection of such data from all non-public schools and its' reporting through the network of regional centers be made available to non-public schools on the same basis as their availability to public schools. This procedure seems indispensable to the healthy functioning of a total netowrk of regional educational information systems to serve elementary and secondary schools.

PART IV ORGANIZATIONAL STRUCTURE FOR A REGIONAL INFORMATION SYSTEM

INTRODUCTION

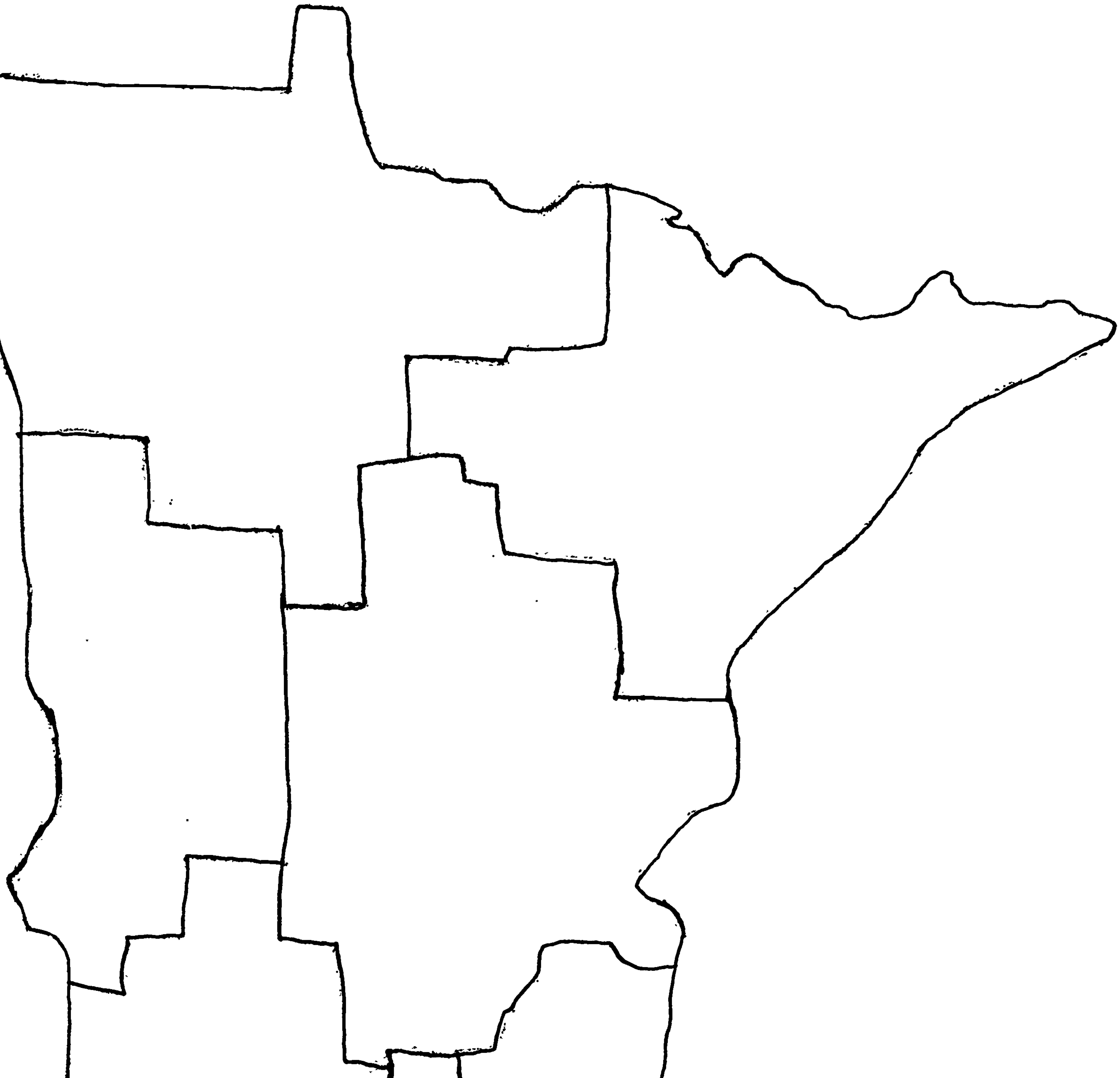
The purpose of this section of the report is to present guidelines for the organization of the statewide network of regional educational information systems and for the organization of the constituent regional educational information system centers. Consideration of the organization patterns for both network and regional levels is centered around the following topics: administrative organization, governance, and financing. The role and status of the regional center within a network system of regional centers is of primary importance. Alternate approaches to regional education information systems are presented and assessed in terms of selected data and concepts presented earlier.

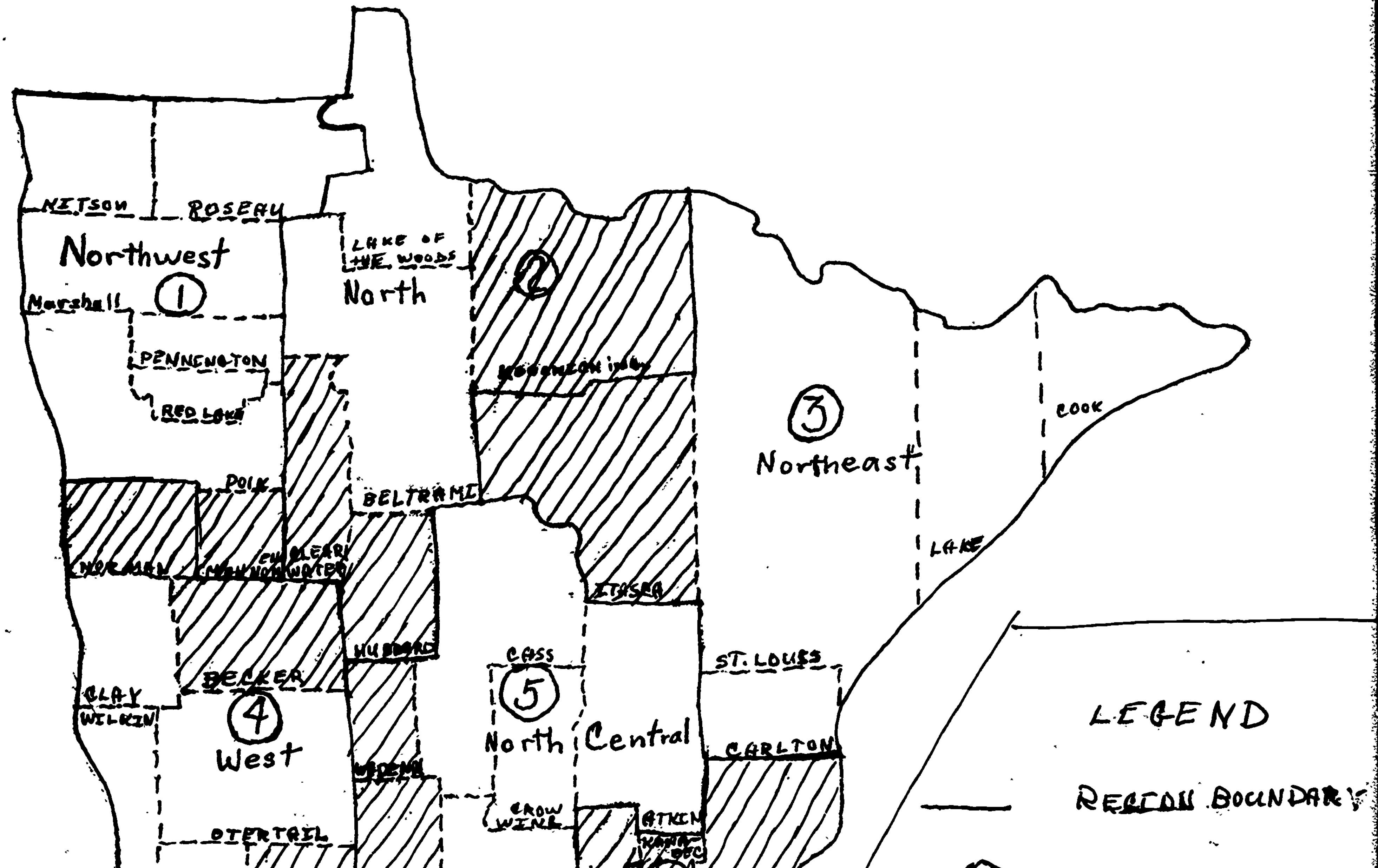
STATEWIDE NETWORK ORGANIZATIONAL ALTERNATIVES

To present alternatives spatial-organizational settings for the implementation of a statewide network of regional educational information systems reference is made to the State of Minnesota Planning Agency descriptions of regional planning areas and regional economic areas (See figures 2 and 3). The regionalization of the State of Minnesota into eleven planning areas has been legitimatized by the Governor's Executive Order Number 37. The State Department of Education has also utilized these eleven regional planning areas in preliminary planning for a statewide network of educational service areas (Minnesota Educational Service Areas). In addition to the use of the eleven planning areas by state planning and operational agencies, developments are underway to establish an integrated information system through a computer-based storage of socio-economic data by county and region. The Minnesota Analysis and Planning System (MAPS) project, directed by Dr. John Hoyt of the University of Minnesota, is developing the software component of this multi-purpose information system.

In proposing alternative spatial-organizational models for a network of multi-district regional educational information systems several assumptions were made:

1. The development of educational information systems must be consistent with the development of economic, social, and physical information systems of a multi-functional type;





LEGEND
REGION BOUNDARY
REGION NUMBER
TRANSITIONAL COUNTIES
CENTAL REGION NAME
Northwest
1
North
2
Northeast
3
West
4
North Central
5
West Central
6
7
Central
8
Southwest
9
South Central
10
Southeast
11
Metropolitan
KITSON
ROSEAU
LAKE OF THE WOODS
Marshall
PENNINGTON
RED LAKE
POLK
NORMAN
CLEARWATER
BELTRAMI
KOOCHICHING
COOK
LAKE
ITASCA
ST. LOUIS
CARLTON
HUBBARD
CASS
CLAY
WILKIN
BECKER
WADENA
CROW WING
OTTERTAIL
GRANT
DOUGLAS
TODD
MORRISON
STEVENS
POPE
TRAVERSE
BIG STONE
AITKIN
PINE
ISANTI
CHISAGO
SHERBURNE
STEARNS
KANDIYOHI
SWIFT
CHIPPEWA
LAC QUI PARLE
YELLOW MEDICINE
RENVILLE
MEEKER
WRIGHT
HENNEPIN
ANOKA
WASHINGTON
CARVER
SCOTT
DAKOTA
GOODHUE
WABASHA
REDWOOD
SIBLEY
NICOLLET
LE SUEUR
RICE
BROWN
LINCOLN
LYON
PIPESTONE
MURRAY
COTTONWOOD
WATONWAN
BLUE EARTH
WASECA
STEELE
DODGE
OLMSTED
WINONA
ROCK
NOBLES
JACKSON
MARTIN
FARIBAULT
FREEBORN
MOWER
FILLMORE
HOUSTON

2. Multi-district regional service areas will be developed in Minnesota during the early 1970's to meet local district needs for a variety of support services;

3. The number of local school districts in Minnesota will continue to decline;

4. Technological advances will make possible remotely accessible computer facilities at a operationally feasible cost;

5. Integrated planning activities at the network or state level assure interchange ability of software, data files, planning, training programs, and computer hardware among the various regional systems; and

6. The regional educational information systems can strengthen the decentralized system of elementary and secondary education through imporving the information base required for policy planning, research, and program administration.

Table 1 presents relevant data for a network of eleven (11) regional educational information systems following the established economic planning regions of the state. The student population pattern in this organization alternative ranges from a low of 16,583 in Region 2 (Northern Minnesota) to a high of 344,875 in Region 11 (Metropolitan). The review of the literature concerning present practice and recommendations for regional educational information systems suggests that this organizational alternative contains a pattern of proposed regions which are too small to provide an efficient and economical base for the development of a regional information system.

The data presented in Table 2 assume the development of a network of seven (7) regional educational information systems. This pattern is based on the seven planning areas initially proposed by the State Planning Agency. This organizational alternative establishes several regional systems of minimal capacity to effectively and efficiently operate regional information systems.

The organizational pattern which establishes regional units of more optimal levels of pupil population is presented in Table 3. The eleven economic planning regions are combined into 4 regional educational information systems: northern, central, southern, and metropolitan. In presenting this organizational alternative as the tentatively recommended pattern for establishment of regional educational information systems, it is not the intent to ignore the unique characteristics of the several regions of the state which may require the adjustment of certain regional boundaries. However, the desirability of establishing regional information systems

Regional Educational Information Systems	Economic Region	Planning Area	No. of Counties	No. of H.S. Districts	1965-66 Enrollment Grades 1-12
1	1	A	7	38	23,386
2	2	A	5	19	16,583
3	3	B	5	33	75,854
4	4	C	10	45	44,895
5	5	D	6	29	29,305
6	6	E	8	42	32,856
7	7	D	10	48	49,920
8	8	E	9	49	34,424
9	9	F	10	53	46,132
10	10	F	10	53	72,732
11	11	G	7	48	344,875
			87	457	770,962

TABLE 1

Regional Educational Information Systems	Economic Region	Planning Area	No. of Counties	No. of H.S. Districts	1965-66 Enrollment Grades 1-12
1	1,2	A	12	57	39,969
2	3	B	5	33	75,854
3	4	C	10	45	44,895
4	5,7	D	16	77	79,225
5	6,8	E	17	91	67,280
6	9,10	F	20	106	118,864
7	11	G	7	48	344,875
			87	457	770,962

TABLE 2

Regional Educational Information Systems	Economic Region	Planning Area	No. of Counties	No. of H.S. Districts	1965-66 Enrollment Grade 1-12
1 (Northern)	1, 2, 3	A, B	17	90	115,823
2 (Central)	4, 5, 7	C, D	26	122	124,120
3 (Southern)	6, 8, 9, 10	E, F	37	197	185,644
4 (Metropolitan)	11	G	7	48	344,875
			87	457	770,962

TABLE 3

General Organization Structure of
The Minnesota Network of Regional
Educational Information Systems

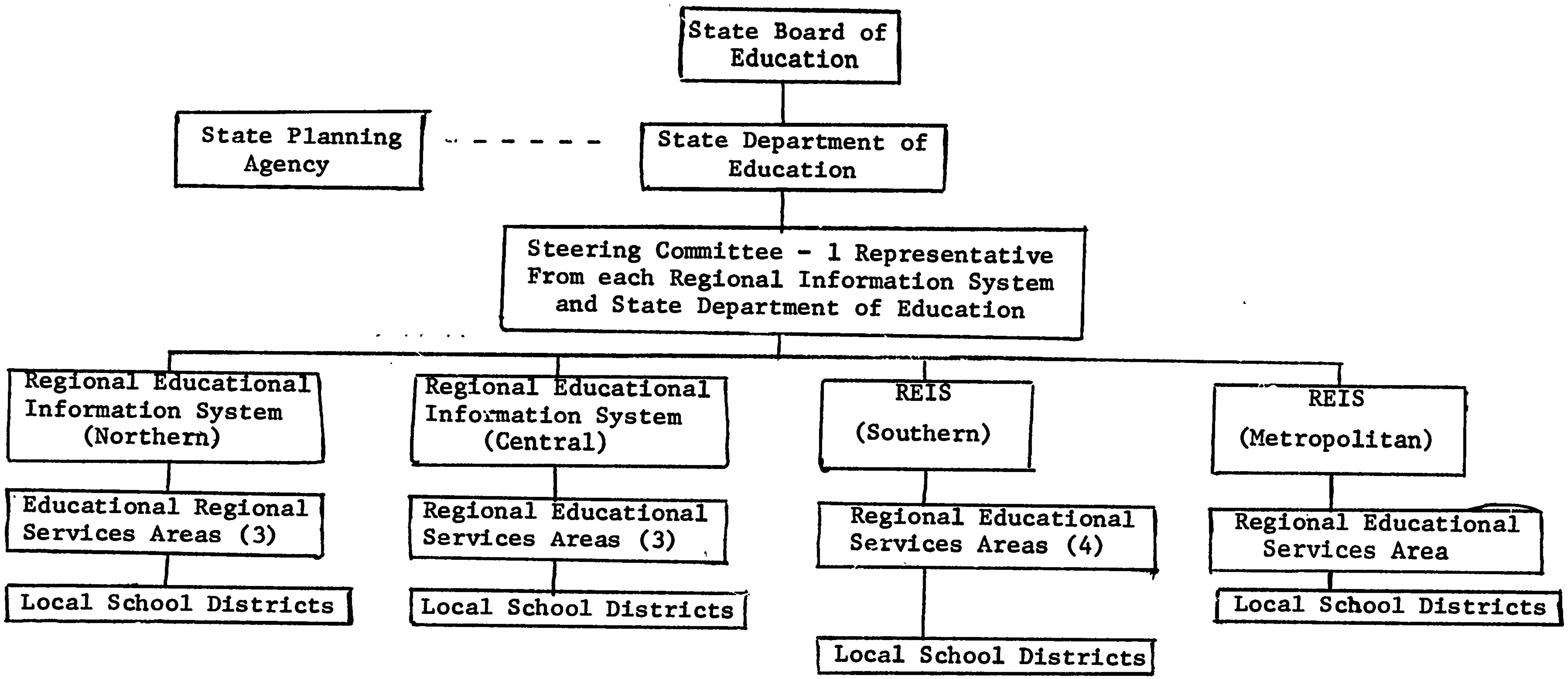


Figure 4

which are modular in relation to state planning regions and the planned multi-functional educational service areas cannot be understated. It is important to note also that each of the four regional educational systems has within its recommended boundaries junior college, state college, and/or university units.

NETWORK GOVERNANCE AND ADMINISTRATION

Figure 4 diagramatically presents the governance and organizational structure involved in the statewide network as represented in the proposed model. It is suggested that the coordination, planning, and development of a statewide network of regional educational information systems is an integral part of the state system of elementary and secondary education and therefore belongs under the immediate jurisdiction of the State Board of Education.

It is recommended that a steering committee, representative of the regional educational information systems be created to assist the State Department of Education in the policy development, planning, operation, and evaluation of the network system and its component regional systems. The steering committee operation should be utilized to assure close coordination, communication, and planning between local school districts, regional systems, and the State Department of Education. Consideration should be given to the creation of a staff position within the State Department of Education, preferably at the level of Assistant Commissioner to provide leadership and administrative support for the development and operation of the network system.

FINANCING THE STATEWIDE NETWORK

The following considerations are proposed for financing the network of regional educational information systems:

1. Support of the regional educational information system network should come from a number of sources, including charges for services rendered to constituent local districts, state aid, federal and foundation funds and taxing authority through constituent regional educational service areas;

2. The full cost of developmental activities; i.e. software development, etc. should be assumed by the State.

3. The regional educational information systems should submit annual operational budgets to the State Department of Education;

4. State aid for support of the operational aspects of the regional centers, exclusive of developmental costs, and based upon approved budgets should be paid directly to the regional systems or an equalized basis;

5. The total state support for the operation of the educational information systems network should initially represent not less than one-half the total operational costs of the network; and finally

6. The state should ensure that the pattern of financial support recognize the desirability of fully participating in the regional educational information system by all local districts regardless of local financial and student resources.

REGIONAL EDUCATIONAL INFORMATION CENTER ORGANIZATION

The concept of an integrated data base supporting a regional information system has been the subject of two large scale studies released during the past year by the U.S. Office of Education. The two reports, "A Feasibility Study of the Central Computer Facility for an Educational System" completed by General Learning Corporation and "A Functional Analysis and Preliminary Specifications for a Single Integrated Center Computer System for Secondary Schools and Junior Colleges" by Computation Planning Incorporated recommend the design and development of educational data processing centers similar to regional cooperative venture under development in Minnesota.

The work of the Total Information for Educational Systems (TIES) project, established and operated by the Minnesota School Districts Data Processing Joint Board has proved that a regional cooperative venture in educational information systems is not only possible but workable. Until recently data processing systems in the Twin Cities Metropolitan area had been confined to separate local school districts. The planning and establishment of the TIES regional center provides a sound prototype for expansion of the regional educational information system concept to all school districts in Minnesota. Prior to presenting general and detailed suggestions concerning the organization, governance, and financing of the proposed regional educational information centers a brief account of history and organization of TIES is necessary.

THE DATA CONTROL SYSTEM

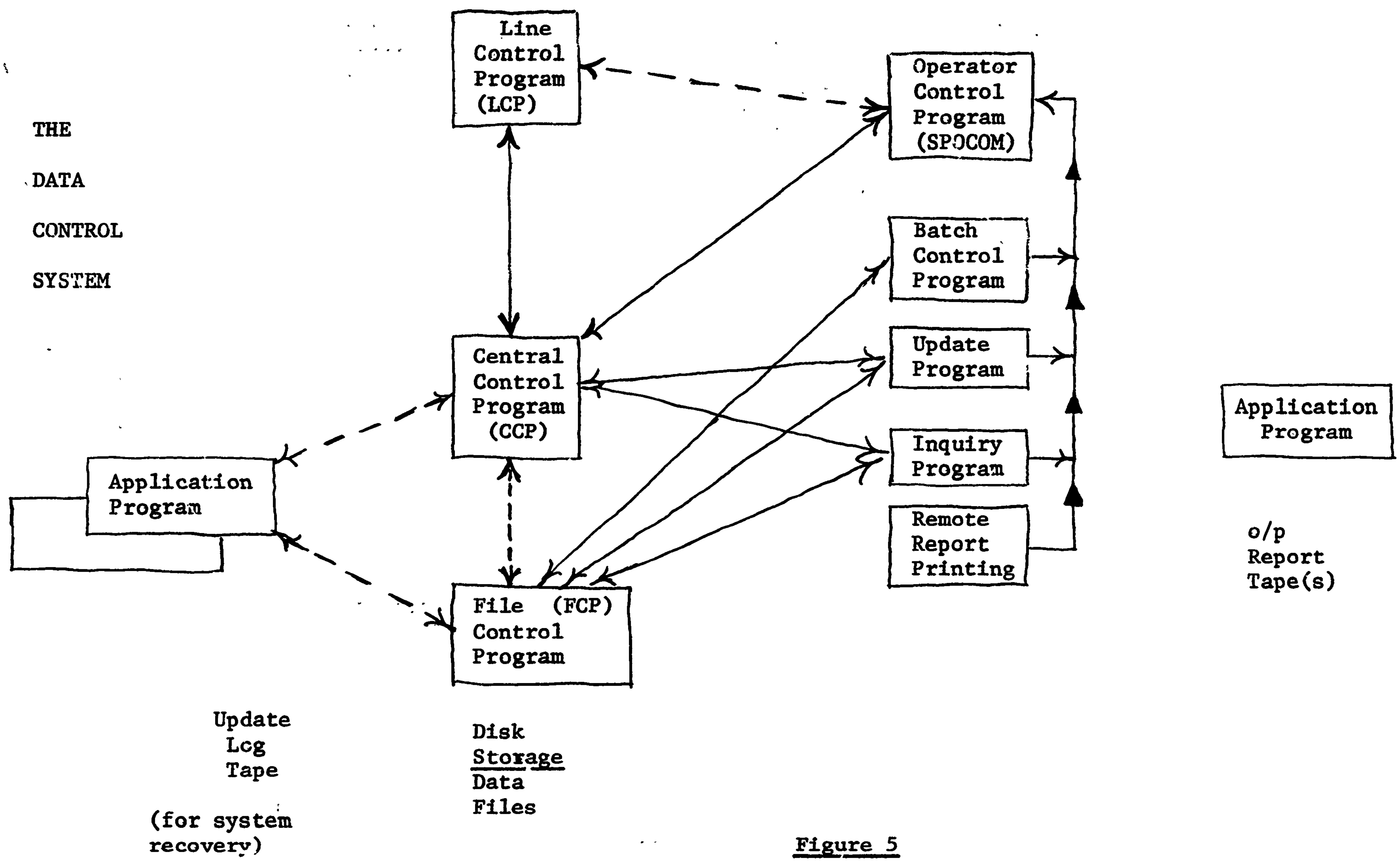
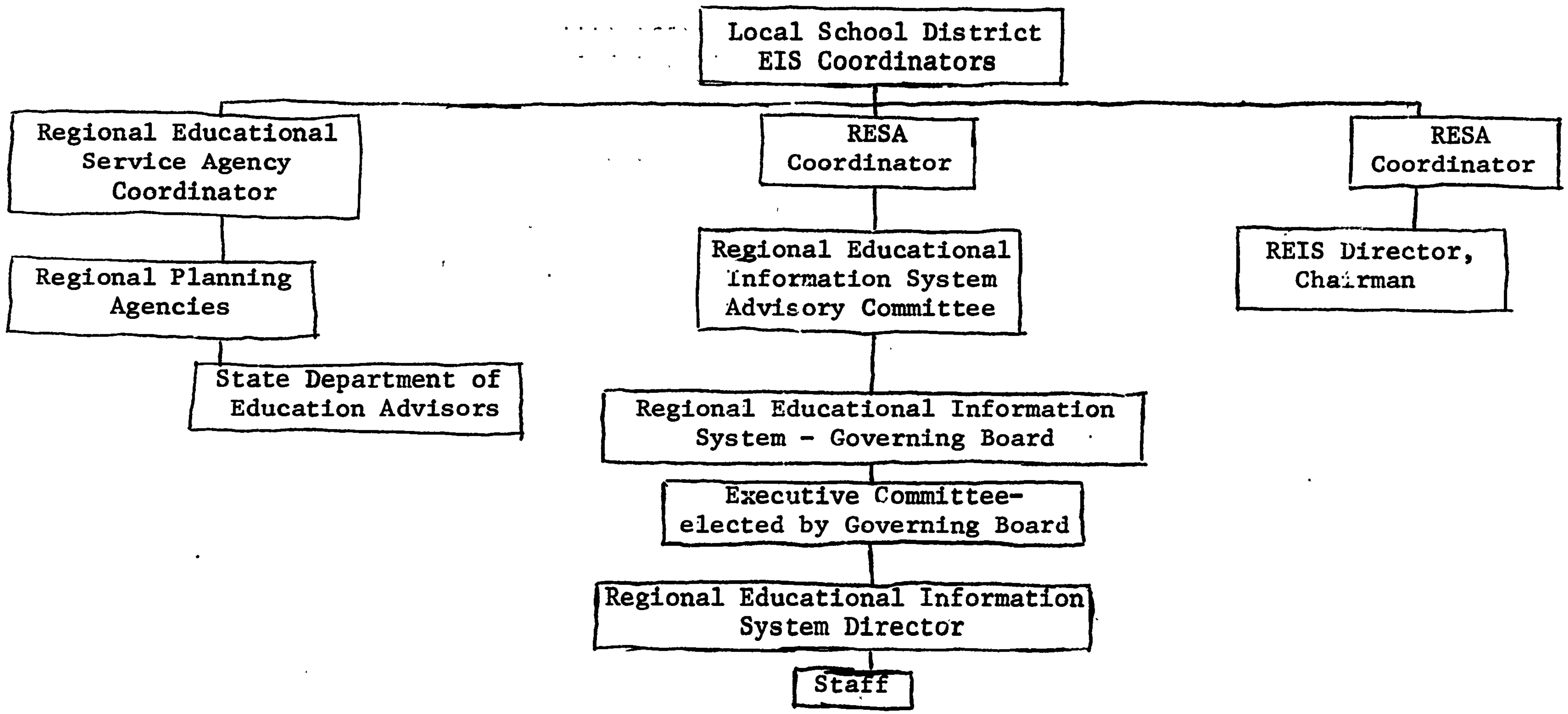


Figure 5



Regional Educational Information System Operational Organization

Figure 6

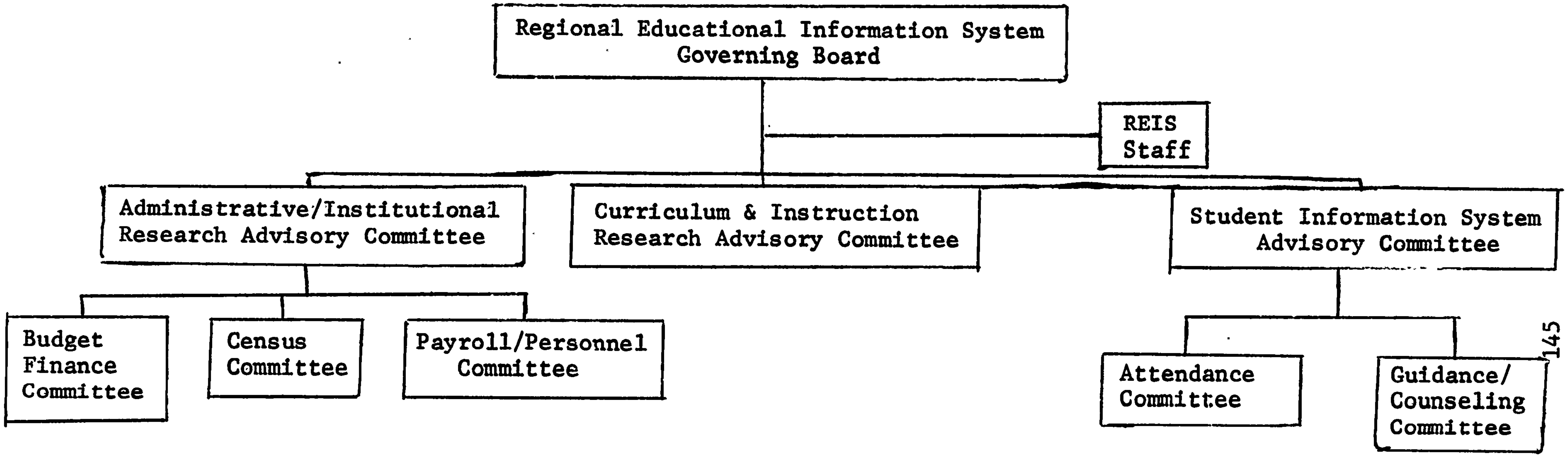


Figure 7 - Regional Educational Information System-
Policy and Technical Committee Structure

OVERVIEW OF THE TIES ORGANIZATION; OPERATING STRUCTURE AND SYSTEMS

TIES is a political experiment created to develop and provide an electronic data processing system servicing exclusively the elementary and secondary schools of the Twin Cities Metropolitan Area. As viewed by the local school district, TIES exists to aid the educator -- by removing the inefficiencies attached to clerical tasks and by providing a mechanism to assist decision-making -- to conduct his school with a maximum concern for the needs and development of the individual student. At the base of every school system is the hope that the individual student will be adequately prepared for the society in which he will work and live. But the realities of operating a school -- such things as production of schedules, report cards, class lists, attendance records, payrolls -- because of their immediacy, require attention and time.

TIES seeks to provide ways to reduce the time and attention taken by these clerical tasks, thereby releasing the administrator and his staff for more important, creative work such as assessment and reorganization of programs and curricula. There are other goals--such as imporving communications and information exchange among local school districts, universities and colleges, the state department of education as well as educational research and organization and dissemination of school data.

The overriding aim of the TIES program is to improve the operating machinery in education so as to individualize the instruction of each student. The pressure to develop ways and means of keeping each student "on target" is increasing with the increasing enrollment pressures placed on local school districts. To achieve this aim, there are several challenges which TIES seeks to meet. Some of the most pressing ones are:

1. To develop a cooperative educational data processing system for member Minnesota school districts.

2. To adapt the computer and data processing to the needs of elementary and secondary education in the areas of administration, instruction, and research;

3. To design an information system which will improve and make more objective the decisions made by school district personnel in all operational levels;

4. To establish a TIES staff concerned with employing data processing to aid and enhance educational opportunity;

5. To establish an information system responsive to personnel and programs in member school districts;

6. To develop a data base and applications by involving district personnel at all stages of systems development;

7. To design and implement an information system operating in a communications on-line environment;

8. To provide for the development of an educational data processing system which may be utilized as a model for the development of a statewide data processing system;

9. To make available to school personnel information resources for better interaction with and instruction of students; and

10. To develop a means of exchange of pupil information to make more efficient and effective the exchanges among school districts and between school districts and the State Department of Education and the U.S. Office of Education.[1]

The governance structure of TIES consists of a Board assisted by an executive committee. The Board consists of two representatives from each constituent district and is responsible for determining TIES policy. The executive committee is elected by the Board and consists of three school administrators and three school board members. The executive committee is responsible for establishing priorities and operating policies and objectives.

The TIES staff is headed by the director of educational services. The director and his staff give overall direction to the operational structure of TIES.

An educational information systems coordinator, the key contact between TIES and the member school districts, is appointed by each school district to deal with all operational matters. His responsibilities to TIES and to his school district are many. Within his school district his job is one of data management which includes acquainting the staff with necessary procedures for using services and data, planning for information needs to meet his districts' re-requirements, and establishing and monitoring input and processing schedules.

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[1]Minnesota School Districts Data Processing Joint Board. TIES-Application for Continuation Grant Project No. OE-67-3987, May, 1969, pp. 9-10.

The operating structure of TIES consists of several areas: (1) management; (2) systems and programming; (3) services and coordination; (4) instruction and research; and (5) operations. The total staff in April 1969 was 30.

The TIES operating system is supported by Data Control System (DCS) of a totally integrated data file. Their system provides the software interface between the terminal devices in the school districts and the central processing unit located at the TIES center.

This system is divided into major functions and programs as follows: (1) Line Control Program (LCP); (2) Central Control Program (CCP); (3) Operator Communications Program (SPOCOM); (4) Remote Report Printing; (5) File Control Program (FCP); (6) Inquiry Program; (7) Update Program; and (8) Batch Control Program. A pictorial diagram showing the interaction of the various programs comprising the Data Control Program is found in Figure 5.

In order to serve requests from individual member districts for special or one-time reports or listings a parameter driven generalized extract program is under development.

Services currently rendered by TIES to its members fall into several categories: (1) administrative, curriculum and instruction, and student information. The input and output of these systems form the universe of data from which the contents of the TIES data base have been planned. Naturally, the flow into the data base will intensify as the number of services increases. The establishment of the data base requires the continued development of two mechanisms: that of data acquisition; and that of institutional cooperation. It is to the construction of these two mechanisms that TIES efforts have been directed. The planning and establishment of the TIES regional information center provides an emergent model for regional educational information systems for Minnesota. The current and planned TIES developments in design as well as practical applications provide a prototype in regional cooperative use of computer technology.

REGIONAL EDUCATIONAL INFORMATION SYSTEM ORGANIZATION

The two charts on the pages that follow have been designed to illustrate how the regional educational information systems could be organized for efficient operation. Figures 6 and 7 graphically depict organizational and personnel relationships. It is to be noted that operational relationships between local school districts, regional educational service agencies and the regional educational information system are dependent upon the Educational Information System (EIS) coordinators at the local district and regional levels. Figure 6 assumes a governance patterns similar to the TIES model with a governing board, executive committee, and internal staffing and management pattern similar to that now employed in the existing regional structure.

Figure 7 presents the proposed policy and technical committee structure for the regional information center as represented in this network model. Under the direction of the regional board and staff a system of policy and technical committees are operational. This extensive involvement of constituent district personnel is necessary if the regional center is to remain responsive to its local districts. The program and services of the regional educational information center must be based on understanding, mutual planning, and the enthusiastic efforts of all prospective users of information.

PART V NETWORK IMPLEMENTATION

INTRODUCTION

The ultimate success of a state-wide computer network is highly dependent upon the planning phase. The development of such a system is large in both terms of personnel and cost considerations. Likewise operational cost will be substantial. The presumption that implementation of such a system will in itself save the taxpayers money is an erroneous conclusion. Presently, the state has an information system, it always has had. The implementation of a computerized information system does not save money, but rather it provides a "higher standard of living" and a means for extracting more output per dollar of input than before. In the long run it will be true that the potential of the computerized regional network will result in substantial savings over deriving the same outputs from some other form of organized system. This however, will only be realized if planning and developmental phase of the project adequately support the operational phase.

This report has directed attention towards those considerations necessary to reaching an optimal design. As suggested previously in the report information systems often become misinformation systems. The development of a state-wide computer requires a major commitment on the part of state government. Financial considerations must view the long-term potential of the system. Cost must be allocated over the lifetime of the system. Only in this manner will a true input-output cost ratio be available and by viewing the system in these terms may planning and development cost be fully justified. Misinformation systems do not just happen. They result from careful planning and development, careful in the sense not to involve a total commitment of personnel and finances.

In examining the phases of network implementation presented in Table 4 it is evident that planning, development and implementation of the system requires substantial time. It is anticipated that the total system could not become fully operational in less than five years witout shortcutting one or more aspects in the planning, development or implementation phases.

GENERAL POLICIES

The establishment of the general policies which would guide the formulation and operations of the network is the direct responsibility of the State Department of Education and specifically the State Board of Education. These policies however should not

Development of a State-Wide Computer Network — Activity	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1. General Policy																								
a) Determination of general objectives	x	x	x	x	x																			
b) Feasibility study	x	x	x	x	x	x																		
c) Review and adoption of feasibility study					x	x																		
d) Legislative approval							x																	
e) Appointment of network director								x																
2. Requirements of the System																								
a) Determination of outputs to be derived from the system									x	x	x	x	x	x	x	x	x							
b) Detailed analysis of needs and planning the organization to provide framework to satisfy those needs									x	x	x	x	x											

Table 4

Development of a State Wide Computer Network — Activity	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
	time scale in months																							
3. Planning the System																								
a) Examination of alternatives									x	x	x	x	x	x	x	x	x	x						
b) Involvement of Equipment vendors as to hardware consideration and feasibility														x	x	x	x	x						
c) Formulation of the System																x	x	x	x	x				
4. Evaluation of the Proposed System																								
a) Preparation of report for adoption of the system																			x	x	x			
b) Agreement as to design of system																						x	x	x

Table 4 (continued)

Development of a State Wide Computer Network	time scale in months																							
Activity	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48
5. <u>Staffing of Network Regional Centers</u>																								
a) Management control staff	x	x	x	x																				
b) Educational consultants	x	x	x	x																				
c) Systems analysts	x	x	x	x	x	x																		
d) Programmers			x	x	x	x	x	x																
e) Operations										x	x	x	x											
f) Training of non-computer staff										x	x	x	x	x	x	x	x	x	x	x	x	x		
6. <u>Systems Development</u>																								
a) Flow drawing and other documentation of systems	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x								
b) Forms of design							x	x	x	x	x	x	x	x	x	x	x							
c) Procedural manuals									x	x	x	x	x	x	x	x	x							

Table 4 (continued)

Development of a State-Wide Computer Network

Activity	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48
	time scale in months																							
7. Programming																								
a) Writing of programs			x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x						
b) Testing of software															x	x	x	x	x	x				
c) Program documentation																x	x	x	x	x	x			
8. Equipment																								
a) Contracts, bidding and purchasing			x	x	x	x	x	x																
b) Selection and Preparation of site						x	x	x	x	x	x	x	x											
c) Delivery and testing of hardware												x	x	x	x	x								
9. Operating Instructions																								
a) Documentation of operating instructions													x	x	x	x	x	x						
b) Instructions for data preparation														x	x	x	x	x	x					
c) Instruction manuals for field personnel															x	x	x	x	x	x	x			

Table 4 (continued)

Development of a State-Wide Computer Network	time scale in months																				
Activity	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
10. Conversion to new system																					
a) Establishment of data banks	x	x	x	x	x	x	x	x	x	x	x										
b) Parallel testing					x	x	x	x	x	x	x	x	x	x	x	x	x				
11. Reliance upon the new system																					
a) Partial											x	x	x	x	x	x	x	x	x	x	
b) Complete																					x

Table 4 (continued)

and cannot be developed in a vacuum. It is true that the State Department of Education is charged with the collection of certain information from local districts. However, it is also true, that substantial usage of the system will be in the areas of data processing such as writing of payroll checks etc. which constitutes a function for which the general policies should reflect the concern of local districts involved and should not be set arbitrarily by the State Department of Education. It should be realized by all that the policies for a successful system cannot result from the input of one or two organizations, but must involve as many organizations as feasible. Although it is the responsibility of the state department to develop such general policies, this development should be formulated in an environment which identifies the state department as performing a leadership function.

Sections 1-4 of Table 4 present four phases necessary in planning for the system. These phases are:

1. General policy
2. Requirements of the system
3. Planning the system
4. Evaluation of the proposed system

Within the framework of the General Policy section, several important steps exist. The first is to determine the general objectives of the system. The determination of these general objectives must be a cooperative effort. It is recommended that the State Board of Education appoint an advisory committee with representation from at least the following areas:

1. State Department of Education
2. Each of the Governor's planning areas sy the elementary-secondary school level
3. Private education
4. Higher education
5. The State Planning Agency
6. The Governor's Advisory Committee on State Information Systems
7. Private industry
8. TIES

It should be the charge of this committee not only to establish the general objectives but also the priorities of such objectives. Concurrent with the development of the general objectives a feasibility study should proceed whereby each objective could be evaluated as to its feasibility within the general framework of the proposed system. The advantage of concurrently conducting the feasibility study is that it permits immediate feedback to the advisory committee such that it may revise objectives and priorities as needed. It is further recommended that the feasibility study be conducted by a private consulting organization and not by the department of education or any subdivision of the major areas of representation on the advisory committee.

From such a study should come a general plan for a statewide network which would be endorsed by the State Board of Education and presented to the next legislative session. The report should direct detailed attention towards proposed statute changes which will require legislative action. Upon review and endorsement of the study by the State Board of Education the advisory committee should be continued with its primary duty to develop necessary political support for passage of various bills which would be introduced in the next legislative session.

Until legislative approval is secured with necessary funding little can be done on the detailed planning phases of the system. The time schedule in Table 4 allocates seven months of time to accomplish this first phase. However this schedule is highly dependent upon the sequencing of events and necessary preparation prior to the legislative sessions and could be extended considerably. Upon legislative approval the project could proceed with appointment of a network director and central staff for detailed analysis of the overall system.

PLANNING AND IMPLEMENTATION OF THE NETWORK SYSTEM

Detailed analysis of the system is indicated by phases two, three, and four. This analysis is of the network as a complete system. Important elements of this analysis are:

1. Compatibility in:

    a. Data elements
    b. Hardware
    c. Software

2. Definitions of interrelationships of the regional centerc with each other and with other agencies.

3. Formulation of governance bodies for each of the regional centers.

4. Involvement of equipment vendors with determination made as to alternatives for equipment purchasing. For example, whether the system will purchase as a unit from one vendor or whether each regional center will purchase separately. (In part this decision will be determined by the sequence of the regional centers, i.e. would they all develop on approximately the same schedule.)

5. Evaluation and final agreement to proceed with the development of the specific regional centers.

Phases two, three and four represent the most important period in development of the network. It is in this period that the real network is displayed. The structure which binds the various regional centers is built during this period. If important considerations are not examined and decided upon at this time the entire network could be impaired. For example the inability to define an adequate and compatible data base could in itself produce several isolated information centers rather than an integrated network. Likewise the compatibility of expensive hardware and software must be carefully and explicitly defined if the network is to function as economically and efficiently as possible. Upon final review and evaluation of the network system by the State Board of Education the process would proceed to phases five through eleven. This time period is primarily concerned with development of each regional center as to the specification of the total network system.

The time scale as presented in Table 4 indicates that about three years would be required for development of each regional center. If the plan of the network system supports the TIES model as acceptable to the regional needs this time span may be reduced. Such a reduction in time and dollars would represent the first in a series of such economies resulting from careful planning and utilization of existing developments. It is anticipated that much of the software development of the TIES project could be utilized by each regional center. In addition the general background and experience of personnel which participated in the TIES project could provide much assistance during the developmental phase of the regional centers. This is not to imply that each regional center should or must become a mirror image of the TIES model but rather those areas in which compatibility exists should be recognized and should be appropriately planned and developed.

It should further be recognized that each center will develop to meet its unique needs. Also each center should be encouraged to initiate development of systems which would be innovative to the network. Each center should and must have opportunity to participate in the developmental research which would continue to strengthen the entire network. It would not be advisable that only one center be permitted to carry out developmental research activities. However, in the interst of economy, it would not be advisable to permit developmental units which is duplicate in nature by two or more of the centers. This entire discussion points to the fact that the organization structure of the network as a whole must be both strong and responsive. It must be strong not to permit duplication and empire building by the regional centers but yet it must not lose sight of the fact that each center has unique needs and further that each center should share in the developmental research necessary to maintain a healthy network.

EVALUATING THE PROPOSED NETWORK SYSTEM

The continued success of any project requires systematic feedback to the control body. Formalized feedback into the organization can result from periodic evaluations of the direction which the organization is pursuing. Such periodic evaluations should be part of the general plan for the state-wide network. It is recommended that the entire network system, including each of the regional centers be evaluated yearly during the developmental phase and at not greater than two-year intervals upon becoming operational. Further, such evaluation should be conducted by an outside agency. Such evaluations should be submitted directly to the State Board of Education. Only by such systematic evaluation can the direction of the network be correctly maintained.